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Guidelines and Tools for VBS2 Mission After Action Reviews: Development and Evaluation

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14. ABSTRACT *(Maximum 200 words)*:

This report documents the creation and evaluation of a guide designed to assist facilitators who conduct after action reviews (AAR) of missions executed using the Virtual Battlespace-2 (VBS2) game. Observations of course-related exercises suggest there is a clear need for the guide. The results of the formative evaluation and an exploratory investigation indicate the guide meets the need. The guide is available as a stand-alone document in ARI Research Product 2011-09, *After Action Review Guide for Trainers of Virtual Battlespace-2 Missions*. It is also a valuable addition to the *Soldiers' Toolbox for Developing Tactics, Techniques, and Procedures,* ARI Research Product 2011-08, that resulted from earlier research. The results of the exploratory investigation strongly suggest that effectively employing VBS2 AAR capabilities is a key factor in engendering "buy-in" for simulation-based training among facilitators and Soldiers. The report includes lessons learned and recommendations for disseminating and utilizing the guide.

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game-based training, after action review ,Virtual Battlespace-2, instructional methodology, desktop simulations , training technology, training effectiveness

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GUIDELINES AND TOOLS FOR VBS2 MISSION AFTER ACTION REVIEWS:
DEVELOPMENT AND EVALUATION

EXECUTIVE SUMMARY

Research Requirement:

As Army trainers embrace desktop simulations such as the Virtual Battlespace-2 (VBS2)
game, the need has emerged for a tool to help after action review (AAR) facilitators put the
game's new simulation-based AAR capabilities into practice. The need exists in the larger
context of developing and communicating tactics, techniques, and procedures (TTP) to keep pace
with the rapidly changing operational environment. To meet the need, the U.S. Army Research
Institute for the Behavioral and Social Sciences (ARI) initiated research to develop tailored AAR
guidelines and tools for trainers of VBS2 missions. The research built on earlier work that
produced a *Soldier's Toolbox for Developing TTP*, equipping units with a Soldier-friendly
package to help them capture and share their hard-won combat lessons.

Procedure:

A user-friendly *VBS2 AAR Guide* was created on the basis of a literature review and
observations of AARs in three separate Army courses. Formative evaluation employed a multi-
stage, multi-source approach. The Guide was initially developed by subject matter experts
(SME) and behavioral researchers through a draft-review-revise process. During AAR sessions,
the Guide was subsequently used by course facilitators, who then provided feedback. Based
upon the feedback received, the Guide was refined and the final product was transitioned to the
target audience.

In concert with the Guide's development, exploratory research was conducted to assess
instructor and student perceptions of the effects of AARs with VBS2 on learning and training
outcomes. After executing a mission using VBS2, experimental groups participated in AARs
that employed VBS2 AAR capabilities. Control groups participated in AARs that used no VBS2
capabilities. Facilitators in the experimental condition used the Guide to structure and conduct
AARs, while control condition facilitators did not. Both qualitative and quantitative data were
collected using observation protocols, surveys, and "after action" discussions and evaluations of
performance.

Findings:

Observational data and feedback indicated that the AAR functions of VBS2 are currently
being underutilized by facilitators. Feedback from participants was positive for all aspects of the
Guide. Instructors indicated the Guide's contents were sufficient and clear, without being
burdensome. Instructors' feedback suggests the Guide is a useful resource and adds substantive
value during the AARs of VBS2 exercises.

Strong support was found for the positive impact of utilizing the Guide during VBS2
AARs. Every instructional aspect of the AAR that was measured, and several aspects of

simulation-based training were rated more positively by students in the experimental condition than the control condition. Observational data indicated a wider range of instructor and student activities during AARs with VBS2 than those without. Observational data also indicated greater student participation in AARs with VBS2. Though limited, instructor data was positive regarding AARs with VBS2. Finally, employment of the VBS2 AAR capabilities significantly increased "buy-in" for simulation-based training among Soldiers.

Utilization and Dissemination of Findings:

The Guide is a useful tool to help trainers bridge the gap between the "art and science" of effective instruction while conducting a VBS2 mission AAR. The results of the exploratory investigation suggest that employing VBS2 AAR capabilities can materially enhance Soldiers' learning. Cadre and facilitators should be made aware of the added value of employing VBS2 AAR features during AARs of VBS2 training exercises. The *VBS2 AAR Guide* is currently being transitioned to the cadre of three courses, has been posted on the MilGaming community of practice website for downloading, and has been incorporated into the *Soldier's Toolbox for Developing TTP*. Finally, a companion research product has been published to facilitate the transition efforts.

GUIDELINES AND TOOLS FOR VBS2 MISSION AFTER ACTION REVIEWS:
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GUIDELINES AND TOOLS FOR VBS2 MISSION AFTER ACTION REVIEWS:
DEVELOPMENT AND EVALUATION

Introduction

As part of the U.S. Army's efforts to leverage the power of computer-based combat simulations, Army trainers are embracing desktop simulations such as the Virtual Battlespace-2 (VBS2) game. This virtual, multi-player, interactive system provides a realistic tactical environment for training collective tasks. Soldiers and leaders execute missions that are driven by operational scenarios and then reflect on their performance in technology-supported after action reviews (AAR). In the VBS2 training environment, trainers can accelerate the AAR learning process by harnessing special feedback capabilities of the software. Given the expanding use of VBS2 throughout the Army, the need has emerged for a tool to help AAR facilitators put the game's new simulation-based AAR capabilities into practice. The U.S. Army Research Institute (ARI) responded to the need by developing tailored AAR guidelines and tools for trainers of VBS2 missions.

In this ARI research, investigators built on previous research that created methods and measures for developing and communicating tactics, techniques, and procedures (TTP). The earlier research led to the construction of a *Soldier's Toolbox for Developing TTP* that incorporated lessons and insights gained from the investigation and evaluation efforts. The Toolbox gave units a Soldier-friendly package to help them capture their hard-won combat lessons and share them with newly arrived Soldiers. The present research expanded the methodology to include methods for communicating TTP in the specialized VBS2 training environment.

This report describes the methods used to develop and evaluate the *VBS2 AAR Guide*, a tool that aims to optimize the benefits of employing the VBS2 system's AAR capabilities. It explains the efforts to investigate how the Guide impacts learning processes and outcomes, and presents the results of the evaluation and investigation work. The report includes a complete copy of the Guide as a handy reference. A companion publication (Green, Leibrecht, & Fite, in preparation) describes and characterizes the *VBS2 AAR Guide*, and explains how to use the Guide in optimal fashion.

Training Support Requirements

The requirements underpinning the present research stem from training and development challenges, feedback dynamics of simulation-situated AARs, and today's imperative to train adaptive Soldiers.

Training and Development

As today's operational environment (OE) continues to transform, Soldiers who can adapt to uncertain and unforeseen challenges have a distinct advantage (Haskins, 2009). Soldiers face an unpredictable and adaptive enemy, which brings unforeseen problems that require capable problem solvers. Historically, Army leaders geared unit training around relatively stable tasks

(Ferguson, 2008). Soldiers were trained to meet minimum standards of performance on tasks which they could efficiently execute in a predictable environment. This strategy is no longer optimal because current missions are increasingly complex due to unpredictable factors. As Field Manual 3-0 (U.S. Department of the Army, 2008) explains, Soldiers now operate in a full spectrum environment that requires adaptive thinking and careful use of judgment.

As new operational requirements and technologies are integrated into the U.S. Army, Soldiers and units are often on their own to determine how a new requirement or technology impacts their existing TTP and tactical standing operating procedures (TSOP). When the unit attempts to adapt to the new requirement or technology, the lack of workable guidance and tools for developing new TTP/TSOP or revising existing TTP/TSOP reduces the unit's ability to keep pace with critical changes. The pace of change in operational requirements and available technology is accelerated by the uncertainties of irregular warfare as well as rapid fielding and modernization initiatives. For these reasons, units require assistance in exploring, developing, revising, communicating, and assessing TTP/TSOP to better respond to the dynamic and unpredictable nature of irregular warfare.

The rapid pace of change across the force has affected the manner in which TTP are developed. Instead of relying on centrally developed TTP, tactical units typically develop TTP as needed, "on the fly" with little formal guidance or structure. According to Army convention (U.S. Department of the Army, 2005), TTP play a central role in unit operations, including mission planning and rehearsal. However, no guidance is provided on how to develop TTP. A procedurally sound, cost effective and Soldier-friendly method for developing TTP is required to keep pace with rapid changes in warfighting capabilities. A more formal way of creating and documenting TTP may increase the effectiveness of the TTP outcomes and facilitate the documentation of "tribal knowledge." Tribal knowledge consists of undocumented procedures and information possessed within a group, but not readily understood to individuals outside of the group.

The AAR as Feedback Forum

Soldiers require feedback about what happened during an exercise. Because of the "fog of war," phenomenon, when an exercise ends, participants sometimes have a limited perspective regarding what happened, based on the information available to them and what they saw, heard, and smelled. This limited perspective is referred to as perceived truth. Ground truth is the term used for the actual events that occurred. Less trained units are expected to demonstrate a greater disparity between perceived and ground truth, simply because much of the intrinsic information that was available was not perceived or used. Events may be happening quickly and are open to differing interpretations. Perceptions and memories of the occurrence, sequence, and timing of events can be greatly distorted–leading to inference of causal relationships which do not reflect the actual facts (Goldberg & Meliza, 1993).

Extrinsic feedback is provided by outside sources—usually observer/controllers or trainers—after an exercise ends. In the Army, the established forum for orchestrating extrinsic feedback is the AAR. It is designed to help Soldiers understand the ground truth situation relative to their perceived truth and to investigate what caused the events to occur as they did.

Extrinsic feedback exposes exercise participants to information that is not ordinarily available to them. Soldier-participants are encouraged to identify their problems and develop approaches to correct them. Extrinsic feedback can provide insights into how to improve or sustain performance in the future.

Extrinsic feedback regarding unit performance focuses on conceptual knowledge rather than procedural knowledge. Such feedback is generally more explanatory than directive in nature. Research has shown that explanatory feedback is superior to directive feedback when it comes to building conceptual knowledge (Moreno, 2006). As described in Army doctrine (Department of the Army, 1993), the AAR is an active process that emphasizes interactive discussion. A facilitator or trainer—the AAR leader—guides the discussion to focus on what happened, why it happened, and how to improve or sustain performance.

Training for Adaptive Performance

Vandergriff (2006) defines adaptability as "the process by which individuals and groups decide rapidly, almost instinctively, to changes in their situation" (p. 43). According to Vandergriff, a Soldier's experience in problem-solving exercises helps him become an adaptive leader. Such experience is important in training so that Soldiers know "what right looks like." When faced with a tactical challenge, what is the best course of action to take? How can Soldiers accomplish a task quickly and efficiently, while minimizing costs to the unit? These questions arise routinely and take on added significance during combat operations, where costs include life-and-death risks for friendly troops and civilians. To work effectively in the OE, Soldiers need skills and attributes that enable them to solve unfamiliar problems in the midst of complex conditions. The Army must explore new methods of training and education to produce warfighters who can think and act more effectively in complex environments.

Background

Previous Relevant Research

Over the past few years, ARI has addressed the need for innovative methods to create and share TTP by conducting a series of focused research investigations. In the initial project (Topolski, Leibrecht, Kiser, Kirkley, & Crabb, 2009), ARI investigators developed a novel method to structure the TTP development process for emerging systems or technologies. Based on Shadrick, Lussier, and Hinkle's (2005) flexible process of cognitive task analysis, the TTP-focused method is a vignette-driven, iterative approach that harnesses knowledge elicitation techniques with groups of military subject matter experts (SME). The approach was found to be effective in developing TTP, but it does not lend itself well to independent use by units (Topolski et al., 2009). To extend the utility of the new method, follow-up work produced a *Soldiers' Toolbox for Developing TTP* that units can use in table-top, simulation, and live training modes to develop and revise TTP (Topolski, Leibrecht, Porter, Green, Haverty, & Crabb, 2010). The TTP Toolbox was successfully transitioned to the Future Force Integration Directorate at Fort Bliss in support of their efforts to field new technologies to the Army.

The findings of that early research led to the realization that communicating TTP and ensuring their understanding are as important as creating and maturing the TTP. Accordingly, the next project in the series investigated the best methods for communicating TTP and for measuring how well Soldiers understand them (Anderson, Topolski, Leibrecht, Green, Crabb, & Lickteig, 2010). Three modes of communication—written, graphic plus written, and video plus graphic plus written—were developed and evaluated. In addition, three techniques for assessing Soldier understanding were constructed—written back brief, multiple-choice questioning, and problem solving based on video modeling. Those findings led to questions about implementing methods for communicating TTP in conjunction with established mechanisms for promoting Soldier learning, such as the AAR. This set the stage for the research presented here, which advanced the line of investigation into the realm of simulation-based training.

Demands on Trainers in Units and Institutions

To be effective, AAR discussions need to be guided by a leader or facilitator. The warfighter leading an AAR needs one or more start points for the discussion and at least a general idea of its direction. Then, by asking open-ended and leading questions, the AAR facilitator gets the Soldier-trainees to relate the significant events that happened during the exercise. The job of the facilitator becomes easier to the extent that he/she is already aware of the types of problems the unit has been experiencing. If all an AAR leader knows about a mission is that the unit sustained heavy casualties, questioning will take a long time to identify the root causes of the problem. The AAR does not require an exhaustive review of all aspects of a unit's performance. Instead, trainers should focus on aspects of performance closely linked to key exercise events and outcomes. Thus, AAR facilitators must be fully knowledgeable, well prepared, and equipped with tools for promoting feedback and learning among the participating Soldiers.

Growth of Training Simulations

The Army faces significant training challenges now and in the years ahead. These challenges include the persistently high operational tempo, deployment pressures on training requirements and schedules, and the Army Force Generation process. Transformation of the Army structure, the complexity of potential domestic and global missions, greater diversity of operational environments, and competing requirements for training resources are all key factors that pressure current and future training realities. Consequently, trainers are relying more and more on low-cost, simulation-based solutions to fill critical training gaps and increase the effectiveness of training for our Soldiers in a time of persistent war.

The U.S. military has a long history of using simulations to train Soldiers. For example, Simulation Networking (SIMNET) is an instructional environment designed to aid in training mounted units. The SIMNET is a virtual, real-time, multi-station interactive network. The second generation of SIMNET emerged as the Close Combat Tactical Trainer (CCTT). The CCTT system incorporated several improvements over the SIMNET suite including the ability to vary light and weather conditions. A limitation of both SIMNET and CCTT is their bulk, restricting their portability. Leveraging personal computer (PC) capabilities, DARWARS Ambush! offered a "lightweight," commercial off-the-shelf training simulation that has been

used widely within the Army. Recently, VBS2 was fielded as a second generation version of DARWARS Ambush! and is currently being employed throughout the Army. While these systems vary along multiple dimensions (e.g., fidelity, sophistication, terrain representation), they all share the ability to train Soldiers and support TTP development.

Role of Simulations

Currently, Soldiers train with the help of simulations for a wide range of skills including working as a team, commanding and controlling operations, making decisions, strategizing, and operating costly equipment (e.g., Prensky, 2007). Overall, training in simulation environments should provide individuals and units with feedback about how their actions contributed to mission success or failure, casualties received, and casualties inflicted on the enemy—the bottom lines of collective performance. According to Prensky (2007), simulations may also be used to expand the range of feasible conditions in which units can train, reduce the requirements for training ranges, avoid the maintenance burden of live training, and bring greater flexibility to unit training schedules. Simulations also can provide high-fidelity realism and practice in competitive situations.

Costs/Benefits of Simulations

Prensky (2001) suggests that the benefits of simulations include lower cost, increased motivation of Soldiers, and greater operational relevance. Simulators are cheaper than using operational equipment, an advantage that applies especially to aircraft (Hays, Jacobs, Prince, & Salas, 1992). However, the initial cost of creating and validating a game-based simulation can be substantial. For example, the U.S. Army invested considerable resources in establishing the CCTT as a robust virtual trainer for team and collective tasks (Mastaglio et al., 2004; U.S. Army Program Executive Office for Simulation, Training, and Instrumentation, 2010). Once the training simulation has been established, the cost of training in a virtual battlefield is less than it would be when using actual equipment on training ranges. In comparison to both live training and virtual simulation, game-based training (GBT) platforms are the least costly option. As an example, the multi-player, internet-based game Spearhead II trains crews on artillery fire control, and it simulates mobility and combat interactions for 25 cents an hour per player (Erwin, 2000). Dome-based simulators with a motion-base and wrap-around imagery cost $5,000 to $10,000 to operate for each hour of useful training.

Several studies support the notion that simulations increase learners' motivation (e.g., Moreno, 2006; Prensky, 2007). Massively multiple online role-playing games (MMORPG) are synthetic arenas where players interact, collaborate, and strategize with others. The nature of MMORPGs challenges players to think critically and plan ahead, while promoting intrinsic motivation through choice, control, collaboration, challenge, and achievement (Dickey, 2007). Using games as instructional tools can increase motivation to learn by more fully engaging the training audience (Vogel, Greenwood-Ericksen, Cannon-Bowers, & Bowers, 2006). These findings are reinforced by America's Army, a game developed as a recruiting tool to inform the eligible population about military service as a Soldier (http://www.americasarmy.com). The game is a PC-based first-person-perspective game where players go through virtual basic training and then complete online military missions as part of a team. As evidence of the game's

motivational allure, figures posted on the game's website indicate there are over 10 million registered players, with 5.4 million having completed basic training.

Regarding operational relevance, preparing small teams of dismounted infantry for urban operations is one of the greatest military training challenges today (Lampton, Clark, & Knerr, 2003). As Lampton and his colleagues note, GBT "supports small unit (fire team, squad, and platoon) training, mission rehearsal, and explorations and evaluation of potential changes in doctrine, organizations, equipment, and Soldier characteristics" (Lampton et al., 2006, p.1). The technology also imposes real-time pacing, vehicle and weapon operating demands, movement and maneuver activities, crew interaction, command and control demands, terrain complexities, and a battlefield environment rich in visual and audio cues. The GBT venue compels Soldiers to apply their tactical knowledge under dynamic conditions that emulate the OE.

After Action Reviews

Description of AARs

According to Morrison and Meliza's (1999) comprehensive analysis, the genesis of the modern AAR may be traced to historian S. L. A. Marshall, who documented events during World War II and the Korean and Vietnam Wars. Marshall spoke with Soldiers in theater and immediately after combat actions. His efforts were arguably the first AARs. The lack of modern technology restricted first-hand observations and documentation of battles, as reporters were limited by space and time.

The modern day AAR process evolved in parallel with tactical engagement simulations. As Morrison and Meliza (1999) note, AARs involve after-the-fact discussion of an exercise where participants can consider the events from multiple perspectives and come to an individual understanding of three key issues:

1. What happened during the collective training exercise? The AAR participants attempt to recount the facts (i.e., the important actions and outcomes) of the simulated battle.
2. Why did it happen? Given the facts of the exercise, the participants attempt to explain the causes of critical actions and outcomes.
3. How can the unit improve its performance? Once the first two questions are answered, the participants determine appropriate actions to remedy notable performance problems. Example actions include changing the unit's standing operating procedures (SOP) or conducting further training with basic drills.

Purpose of AARs

Bringing together contrasting accounts is often the key element in an AAR. In a team exercise, individuals view success and failure through the lens of their individual perceptions and decisions. However, given the distributed nature of these exercises, an individual's perspective is frequently biased or misleading. For example, what seems like a bad decision from the perspective of a subordinate might make more sense if he were placed in his commander's shoes. By collectively discussing events after the mission ends, decision makers can come to a truer understanding of who did what, why, and how they can do better the next time. Based on greater

understanding and objective insights, leaders can improve their unit performance by developing or refining their TTP and ensuring that their Soldiers thoroughly understand the new TTP.

Benefits of AARs

Well structured AARs provide units with an improved perspective on what actually happened during an exercise—a perspective that more accurately reflects ground truth. An important goal of the unit is to identify corrective actions to improve every Soldier's perspective as training and operations proceed, thereby generating better intrinsic feedback to cue and guide unit behavior.

Morrison and Meliza (1999) provided part of the reason for the AAR's success by tracing its basis in behavioral science principles. Those principles include feedback, performance measurement, memory, group interaction, information sharing, and instruction. Objective standards and computer-based data collection ensure measureable performance. Feedback includes execution data and options for changing or improving future activities. This occurs as the AAR facilitator coaches the unit through self-discovery. Immediate memory plays a key role during an AAR, while take home packages provide reference materials for later study. Group problem solving techniques help units to understand what happened and how to make changes. Interpersonal interactions come from cohesive groups sharing individual views in a non-threatening environment with an AAR facilitator. Guided by the facilitator, the unit identifies its own fixes as its Soldiers engage in active learning (see Morrison & Meliza, 1999, p. 24-25, for a comprehensive discussion). In theory, then, the AAR is a continuous learning process reflecting the desire to improve/sustain performance or the need to change behavior in order to achieve more favorable outcomes.

Research Objectives

The current research aimed to develop innovative methods and materials to help trainers enhance the effectiveness of VBS2 AARs. The products of the research were intended for use by AAR facilitators in institutional and unit settings. An underlying goal was to extend the reach of the previously constructed *Soldier's Toolbox for Developing TTP* into the simulation-based training environment. The following research objectives guided our efforts:

1. Survey best practices that are applicable to simulation-situated AARs.
2. Translate best practices into guidelines and tools to support AARs of VBS2 missions.
3. Package the guidelines and tools in a facilitator-friendly guide.
4. Formatively evaluate the guide in institutional settings.
5. Investigate the guide's impact on AAR processes and training outcomes.

The VBS2 was chosen as the gaming platform of interest for several reasons. First, it is widely used by Army organizations including the Training and Doctrine Command's Centers of Excellence. Second, VBS2 is capable of supporting mounted and dismounted operations. Third, VBS2 provides a robust family of AAR capabilities including recording and playback, bookmarking, flexible camera views, and other features. Finally, VBS2 enables trainers to readily vary OE factors such as mission, friendly troops, enemy, and terrain.

Method

The purpose of this research was to develop a Guide to assist facilitators with applying VBS2 AAR capabilities during AARs as part of simulation-based training. The development process called for a formative evaluation of the Guide. In addition, the research measured the impact of using VBS2 AAR capabilities on AARs and instructor and student perceptions of simulation-based training. Construction of the Guide began with a front-end analysis of the best practices from industry, academia, the military, and VBS2 circles. The results of the analysis were used to develop educational materials, procedural guidelines, and a job aid. The resulting Guide underwent operational implementation and multiple-stage, multi-source evaluation with representatives of the target audience.

Front-End Analysis

An extensive review of the U.S. Army's AAR doctrine, research and technical articles from academia and industry, and VBS2 training manuals was conducted. Army doctrine was examined to ensure the Guide would be consistent with the established structure and practices of an AAR. Research articles were reviewed to identify best practices and avoid common pitfalls and shortcomings in constructing the Guide. Training manuals for the VBS2 system were used to specify VBS2 capabilities, terminology and system requirements.

Interviews were conducted with representatives of the target audience. Limited to selected training institutions, the target audience representatives included course managers, instructors and SMEs. The interviews focused on determining user needs and preferences for the Guide. Observational data was recorded during course-related AARs to gather additional information about facilitators' current practices. Finally, the research team also examined the available documents and presentation materials from lectures and workshops pertaining to VBS2 AARs. Selection of the lectures and presentations was based on the military background, simulation experience, and favorable third-party comments regarding the presenter(s).

Initial Development of the Guide

The results of the front-end analysis—doctrine, best practices, principles, lessons learned, etc.—was used to prepare guidelines for conducting AARs with the aid of a VBS2 workstation. Several sources from the literature review provided direct support in this step. For example, Training Circular 25-20, *A Leader's Guide to After-Action Reviews* (Department of the Army, 1993), outlined techniques and procedures for conducting a sound AAR. Several other documents (e.g., Allen & Smith, 1994; Meliza, 1996, 1998; Salter & Klein, 2007) contributed useful accounts of the goals, structure and processes of an AAR. The *VBS2 Administrator Manual* (Bohemia Interactive Australia, 2010) was used to outline the VBS2 capabilities and limitations, as well as the workstation requirements. Assembled in outline form, the guidelines were reviewed by our team and revised.

Based on the revised guidelines, a concise facilitator's Guide containing orientation and educational materials, procedural guidelines organized by AAR stage, and a job aid that listed the AAR capabilities of the VBS2 system was constructed. Also included was a list of sources

of additional information. As part of the initial development, multiple reviewers vetted the draft versions. Following each review, revisions of the Guide were accomplished as needed.

Formative Evaluation

Stages and Events

The formative evaluation was structured around two broadly defined stages. The first stage consisted of iterative vetting of the Guide. The vetting was performed by SMEs and academic experts to ensure the Guide adhered to AAR doctrine, contained correct VBS2 terminology, accurately conveyed VBS2 capabilities and limitations, sufficiently outlined the necessary skills and required equipment, and comprehensively outlined the desired steps for conducting an AAR with VBS2 tools. The Guide was then reviewed by a behavioral scientist using the same criteria. Following each vetting cycle, the Guide was revised based upon the feedback.

In stage two, the Guide was field tested by instructors in three separate courses at two U.S. Army schoolhouses. Instructors were asked to evaluate the acceptability and usability of the Guide. In addition, feedback was solicited on which sections could be clarified, expanded, reduced or deleted. The testing procedure occurred in multiple cycles, with each group of instructors given several opportunities to provide feedback on the Guide.

Participants

The participants for the formative evaluation were current course instructors including both active military and contractor SMEs. Five instructors provided written and/or verbal feedback regarding the Guide.

Materials

Feedback data was collected from participants using the Instructor Feedback Form and the Instructor Profile and Survey (see Appendix B). The forms contained a mix of open-ended, rating scale, and check-all-that-apply questions. The questions focused on three main topics: the acceptability of the Guide, the usefulness of the Guide, and suggested changes to the Guide.

Data Collection Procedures

Participants were given a hardcopy of the Guide to review, along with the Instructor Feedback Form to complete. They were asked to thoroughly review the Guide and provide any comments or suggestions they felt appropriate. While the Guide was distributed to approximately three dozen participants, feedback forms were received from only three. This reflected the time pressures and competing priorities of the institutional environment. The Instructor Profile and Survey was administered to course instructors immediately following an AAR with VBS2. The survey took approximately 5 min to complete.

Exploratory Investigation

An exploratory investigation was performed to assess the effects of the Guide and VBS2 AAR capabilities on learning outcomes and the AAR process. The sampling domain included instructors and students in three Army courses. The investigation design for instructors was a self-selection, small sample model, emphasizing descriptive data. The investigation design for students was a between-group model with a non-random sample. The independent variable focused on the use or non-use of VBS2 capabilities during the AAR session: the experimental condition was defined as AAR with VBS2, while the control condition was defined as AAR with no VBS2. The Guide was distributed to all of the instructors, both experimental and control, at least one week prior to conducting their AARs. Multiple sources of data included hand-recorded observations, written and verbal feedback, and psychometrically scaled ratings.

Participants

Instructors and students were drawn from courses taught by (a) the Maneuver Center of Excellence at Fort Knox, Kentucky, and (b) the Maneuver Support Center of Excellence at Fort Leonard Wood, Missouri. Instructor and student participants came from two courses at Fort Knox: the Advanced Leaders Course (ALC) for Cavalry Scouts and the Army Reconnaissance Course (ARC). At Fort Leonard Wood the participants consisted of instructors from the Basic Officer Leaders Course (BOLC) for Engineer Corps officers. This population was chosen because the courses already integrated VBS2-based training within their program of instruction, and the training missions involved mounted and dismounted operations. As is typical for such courses, the instruction focused on teaching TTP and TSOP at the small unit level.

Numerous factors limited the instructors' participation. Meetings and other regularly scheduled course activities prevented some instructors from completing the data collection instruments following the AARs. In addition, the ALC program was relocating to another installation, producing extra time pressures on instructors. As a result, the quantity of data collected was uneven across measuring instruments. Some instructors completed only the instructor feedback survey, while others participated in the hotwash only (i.e., did not complete an instructor survey).

The effective sample size was further reduced by the level of participation exhibited by instructors during the AAR. While two instructors were always physically present, one led the AAR while the second typically performed other duties (e.g., completing paperwork, planning the next exercise, or other duties not directly related to the AAR). The research team concluded that collecting data from the secondary instructor would not be valid.

Three instructors completed the Instructor Profile and Survey, all from the experimental condition. The average length of military service for the instructors was 213 months ($SD =$ 151.40). The average length of time as an instructor for the current course was 14 months ($SD =$ 3.46). Prior experience with VBS2 training varied from "some experience" to "much experience," while prior experience with other simulations such as DARWARS Ambush! was consistent for all instructors at "some experience."

Data was collected from 55 students in the ARC (n = 17) and ALC (n = 38) courses at Fort Knox. Data from two students was dropped from the analysis since both students were not U.S. Soldiers and indicated they did not fully understand English. This resulted in a final sample of 53 students. The students were not randomly assigned to either condition; assignment was based upon the instructors' willingness to conduct the AAR utilizing the information provided in the Guide and the VBS2 AAR capabilities. Of the 53 students, 31 served in the experimental condition (AAR with VBS2) and 22 in the control condition (AAR with no VBS2).

Biographical data was examined for any differences between the groups. An independent t-test revealed no significant difference in length of service (months) between students in the experimental condition ($M = 92.52$, $SD = 55.8$) and the control condition ($M = 79.55$, $SD = 56.56$). As seen in Figure 1, the experimental condition contained a higher percentage of sergeants, while the control condition contained an even mix of sergeants and lieutenants.
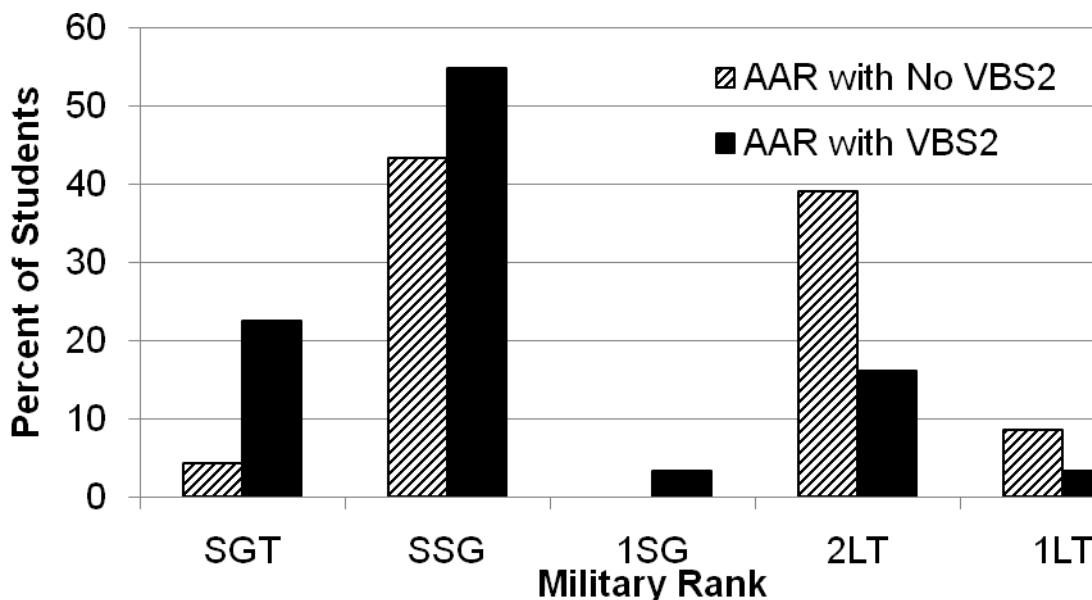
Figure 1. Distribution of students' military rank, by research condition.

Biographical data was also examined for students' prior experience with VBS2 and other simulation-based training. As shown in Figures 2 and 3, respectively, the majority of students reported no previous experience with VBS2 or other simulations prior to the course. Those data suggest that subsequent student ratings for VBS2 and simulation-based training could largely be attributed to their experiences in the current courses and the experimental manipulation, as opposed to past experiences. In addition, students in experimental and control conditions appeared to have very simliar levels of prior experience with VBS2 and other simulations, indicating that both groups were comparable on this measure.
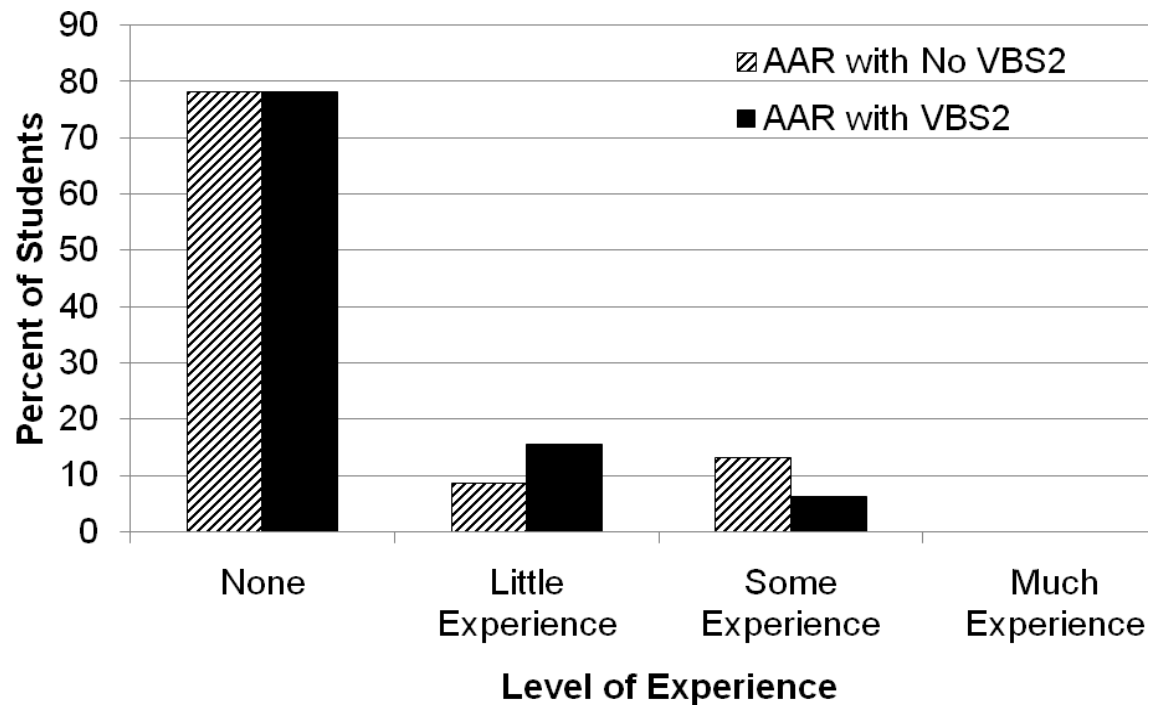
Figure 2. Students' prior experience with VBS2, by research condition.
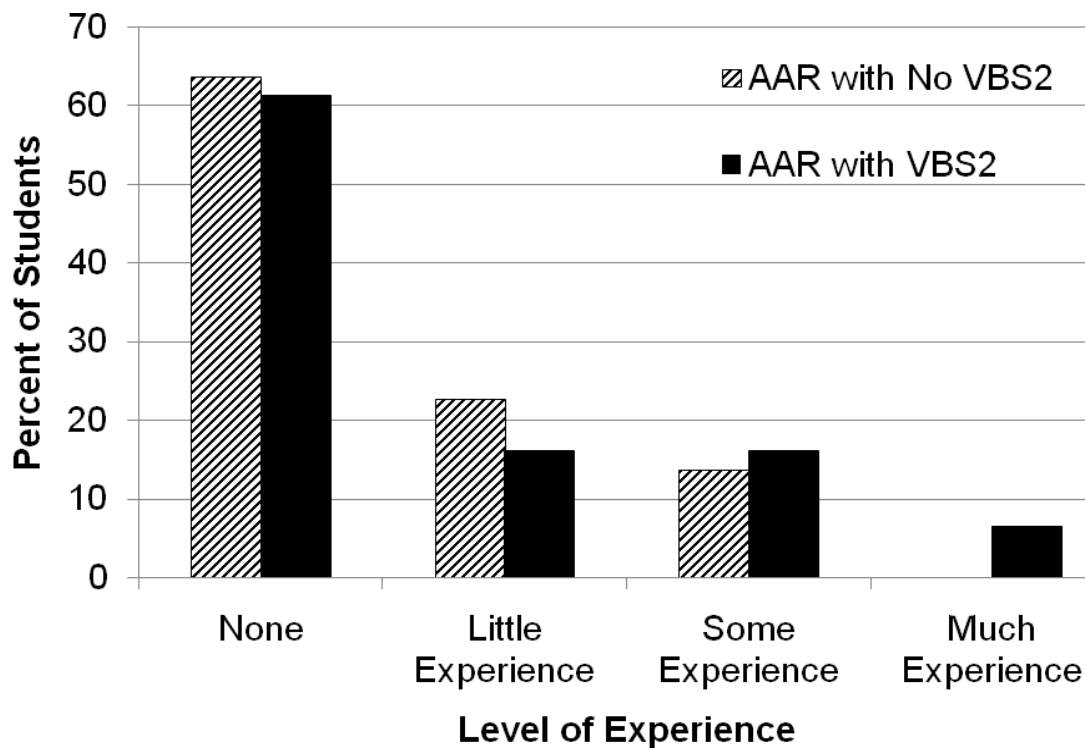
Figure 3. Students' prior experience with computer based simulations, by research condition.

Data Collection Materials

To assess the effects of incorporating VBS2 AAR capabilities during AARs, multiple types of data were collected. An observation guide was used to record the frequency and types of interactions and behaviors of instructors and students. Instructor and student questionnaires were developed to gather biographical data and measures of participants' impressions of the effects of the Guide and VBS2 AAR capabilities on AARs and student learning. The questionnaires contained Likert-type scales and open-ended questions. All Likert measures were five point scales, with "1" representing "strongly disagree," "3" being "neutral," and "5" being "strongly agree." Higher scores translate to more positive ratings. A hotwash protocol was created to structure interviews with instructors in order to obtain additional qualitative data. All of the data collection instruments are provided in Appendix B.

Procedures

The exploratory investigation tapped multiple sources of data to provide converging evidence of the effects of the Guide and VBS2 AAR capabilities on learning outcomes and the AAR process. Instructors received the Guide as much as two weeks prior to their AAR, but they typically studied the Guide and prepared for the AAR shortly before the training event. During the AAR, one of the research team's trained observers used 3 or 5 min intervals to record the frequency and types of interactions and behaviors for instructors and students. The average duration of the AARs was 23.00 min ($SD = 7.21$) in the experimental condition and 33.33 min ($SD = .58$) in the control condition. The difference can be attributed to the AAR with VBS2 conducted at Fort Leonard Wood, which lasted approximately half as long (15 min) when compared to the other AARs.

For instructors, a single subject design was employed, while a between-group design was employed for students. Immediately following the AAR, the instructors and students were given their respective questionnaires, which took approximately 5 min to complete. Afterward, the students were dismissed and the researchers spent approximately 20 min conducting the hotwash with instructors using the protocol. Instructors' verbal comments were recorded and transcribed by the interviewers.

Results and Discussion

Formative Evaluation Results

In the formative evaluation of the Guide, feedback from course instructors and SMEs served as the primary data source and provided valuable information to direct refinement efforts. The feedback gathered during the evaluation was generally positive. Comments and suggestions for revisions were relatively minor and were incorporated into the final version of the Guide. The formative evaluation results will be organized according to three categories: acceptability of the Guide, utility of the Guide, and suggested improvements to the Guide.

Acceptability of the Guide

Data collected from Likert scales indicated instructors found the Guide to be well written and appropriately detailed. As seen in Table 1, ratings were uniformly positive for all aspects of the Guide's quality. This data was consistent with the instructors' and SMEs' written and verbal comments regarding the acceptability of the Guide. Instructors stated the Guide was "very clear and understandable" and "easy to read."

Table 1

Instructor Ratings of Acceptability of VBS2 AAR Guide

How much do you agree or disagree that the *VBS2 AAR Guide*:	Instructor 1	Instructor 2	Instructor 3	Mean (*SD*)
Is clearly written?	4	5	4	4.33 (.58)
Contains the right level of detail for facilitators?	4	5	4	4.33 (.58)
Avoids unnecessary or excess information?	4	5	4	4.33 (.58)
Is well organized and easy to follow?	4	5	4	4.33 (.58)
Uses language familiar to facilitators?	4	5	4	4.33 (.58)

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Utility of the Guide

Written and verbal feedback was used to assess the perceived usefulness of the Guide. Instructors' responses indicated that they believed the Guide was very useful. All of the ratings were positive and more than half of them yielded the maximum rating of "5." Instructor comments echoed the positive ratings for the utility of the guide (e.g., "this can be a very useful tool"). But the comments also reflected some caution regarding how the VBS2 AAR functions should be used (e.g., "the playback should not become the focus of the AAR").

Table 2

Instructor Ratings of Utility of VBS2 AAR Guide

How much do you agree or disagree that the VBS2 AAR Guide:	Instructor 1	Instructor 2	Instructor 3	Mean (*SD*)
Is a useful aid for incorporating VBS2 tools into an AAR?	4	5	4	4.33 (.58)
Is a valuable addition to conduct VBS2 exercises?	4	5	5	4.67 (.58)
Can help facilitators achieve learning outcomes?	4	5	5	4.67 (.58)

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Instructors' written and verbal feedback did not suggest the need for major modifications to the Guide. As a general rule, instructors indicated the Guide was "fine as is, nothing should be changed" and "it is a well put together Guide, I don't know how you would improve it." One instructor recommended the use of a laminated pocket-sized version of the Guide to allow for easier use during the AAR.

Investigation Results

Characteristics of AARs

Observational data was recorded during the AARs to quantify the frequency and types of activities. The data suggested that AARs involving VBS2 capabilities significantly influenced the frequency and types of actions performed by instructors and students. As shown in Figure 4, both instructors and students engaged in a wider array of behaviors in the AAR with VBS2 condition than the AAR with no VBS2 condition. Students were also more active participants in the AAR with VBS2 condition. While students' behaviors accounted for 55% of recorded behaviors in the AAR withVBS2 condition, compared to 51.6% in the ARR with no VBS2 condition, the difference was not statistically significant, $\chi 2$ $(1, N = 104) = .12, p = .73$. The relatively small sample size and infrequency of some behaviors made a more refined analysis impossible. For instance, several behaviors were not observed, such as "student writes" and "student sketches." Observers' notes also indicated that a greater number of students actively participated in the AAR with VBS2 condition. Approximately 1-2 students did not contribute comments during each AAR with VBS2, while 2-3 failed to contribute during each AAR with no VBS2.

Impact of the Guide and VBS2 AAR Capabilities on Training Outcomes

Observational data indicated that the Guide played a central role in how instructors employed VBS2 AAR capabilities to achieve training outcomes during AARs. In accordance with the Guide, instructors in the AAR with VBS2 condition consistently used the 2-dimensional and 3-dimensional map views to review the commanders' intent and mission at the beginning of the AAR. Bookmarking was used as an editing tool to compress the time spent reviewing the critical events. Playback views were varied to capitalize on the facilitator's ability to review individual and group actions. Three noteworthy examples will be discussed:

1. One facilitator varied camera angles between map view, first-person view, and free camera view to illustrate troop movements relative to the enemy. By alternating between these views, he helped Soldiers to realize that some of their actions diverged from the commander's intent.
2. Facilitators used the first-person view during dismounted maneuvers to hold students accountable for their actions. In one instance of fratricide, the student claimed from his viewpoint that the victim looked like enemy. The facilitator used the first-person view to demonstrate that from the student's vantage point the victim could be clearly identified as a friendly civilian. In another instance a Soldier did not take the exercise seriously and

ignored the mission. The facilitator was able to use the first-person view from the enemy's perspective to illustrate how that Soldier's actions gave away the unit's position and endangered his unit.

3. A facilitator used the free camera and first-person views to illustrate how a mounted unit failed to successfully recon an objective. In the scenario, the Soldiers drove past a motorcycle parked against a tree in the woods – failing to see it, even though it was in their line of sight. The motorcycle provided a vital cue that enemy elements were in the area. Without VBS2's AAR capabilities, it would more difficult for the facilitator to review with Soldiers this critical cue. This facilitator also used the first-person view to discuss with Soldiers how they could have improved their line of sight by positioning their tank in a tactically superior position.
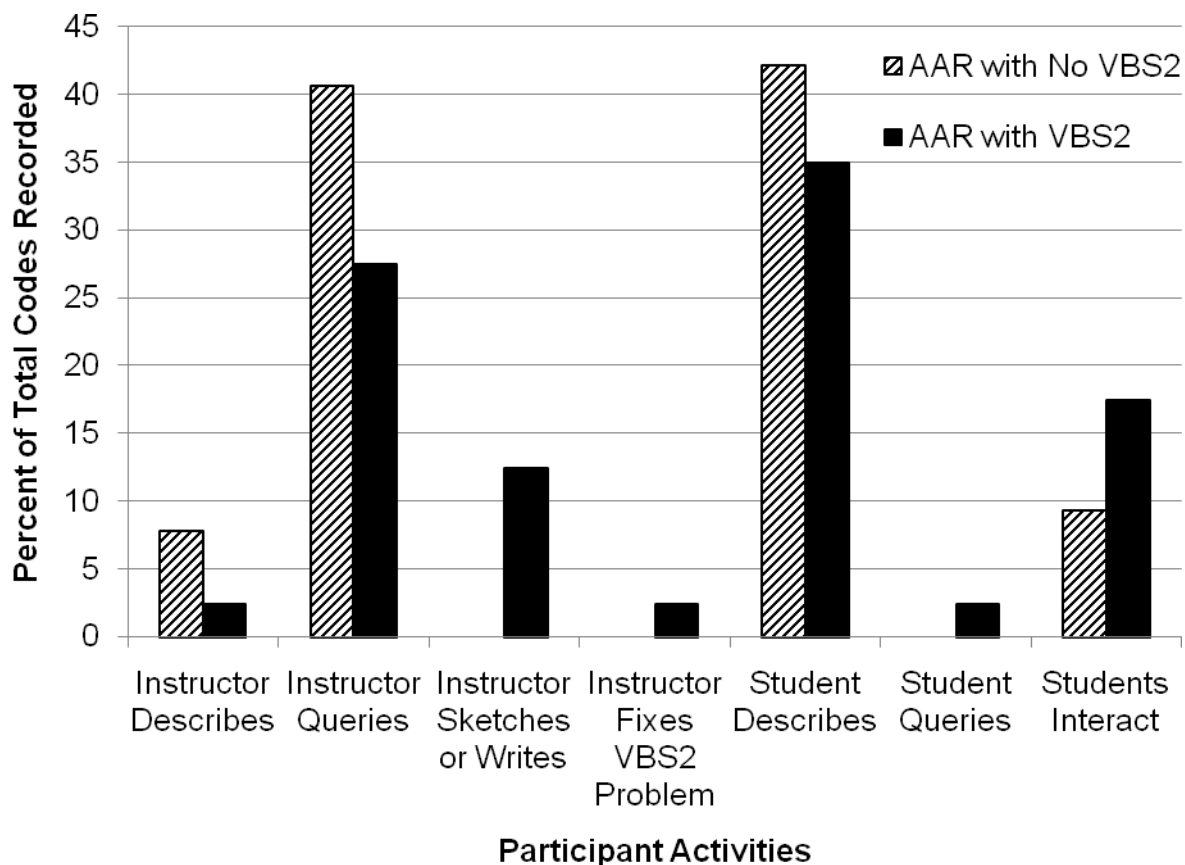
Figure 4. Participants' behaviors during the AAR, by research condition.

The instructor and student feedback surveys contained Likert scale items and open-ended questions for written feedback designed to assess the impact of the Guide and VBS2 AAR tools on AARs. The items were derived from the established objectives of an AAR (Department of the Army, 1993). The data from instructors, which is descriptive and represents a small sample, is presented separately from the student data, which is inferential and represents a larger sample. As appropriate, between-group comparisons are presented in the following sections.

Instructor data

Only data from instructors who conducted AARs withVBS2 was collected, since instructors in the AAR with NoVBS2 condition had no basis for comparison. The results (see Table 3) imply VBS2 AAR capabilities were perceived to have a positive impact on AARs. Out of the 30 responses received, only 10% were negative (i.e., less than a score of "3"), compared with 70% positive (i.e., greater than "3").

Table 3

Instructor Ratings for Training Outcome Effects of AARs with VBS2

How much do you agree or disagree that:	Instructor 1	Instructor 2	Instructor 3	Mean (*SD*)
VBS2 playbacks enhance the AAR by providing a viewable record to draw teaching points from?	4	2	5	3.67 (1.53)
VBS2 playbacks during AARs promote accountability by eliminating uncertainty about who did what?	4	3	5	4.00 (1.00)
VBS2 playbacks during AARs make it easier to focus on specific mission essential tasks?	4	3	5	4.00 (1.00)
VBS2 inspires students to participate in the AAR?	4	3	5	4.00 (1.00)
Varying the camera angles of the VBS2 playback allows for better visualization of the battlefield?	4	3	5	4.00 (1.00)
Alternating friendly and enemy Soldiers' points of view fosters discussion of teaching points?	4	3	4	3.67 (.58)
The value of performing a VBS2 mission was enhanced by watching the playback during the AAR?	4	2	5	3.67 (1.53)
A video playback of the VBS2 exercise is useful during the AAR?	4	2	5	3.67 (1.53)
A video playback from the VBS2 exercise should be a standard component of the AAR?	4	3	5	4.00 (1.00)
The VBS2 AAR Guide is a useful resource for conducting VBS2 enhanced AARs?	4	4	4	4.00 (.00)

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Table 4 shows instructors' ratings for AARs with VBS2, in comparison with traditional AARs. Once again the results were favorable for AARs using VBS2 tools. Of the 24 responses received, 83% were favorable for AARs with VBS2 (i.e., greater than "3"), while no ratings were unfavorable (i.e., less than "3").

Table 4

Instructor Ratings for Learning Impact of AARs with VBS2

Compared to traditional AARs, how much do you agree or disagree that:	Instructor 1	Instructor 2	Instructor 3	Mean (*SD*)
The VBS2 playbacks made your job easier as the instructor by providing a viewable record of events?	4	3	5	4.00 (1.00)
The free camera view and map views (2-D and 3-D) provide a better display of the AO?	4	3	5	4.00 (1.00)
The VBS2 playback better enables students to visualize the AO and actions during an AAR?	4	3	5	4.00 (1.00)
VBS2 playback provides additional detail and clarity of events that occur during the exercise?	4	4	5	4.33 (.58)
The VBS2 playback better allows students to identify any deficiencies which may have occurred?	4	3	5	4.00 (1.00)
The VBS2 playback better allows students to understand how to correct deficiencies?	4	4	5	4.33 (.58)
The VBS2 playback better allows students to focus on performance of specific mission essential tasks?	4	4	5	4.33 (.58)
The VBS2 playback better allows students to identify strengths and actions correctly performed?	4	4	5	4.33 (.58)

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Student data

Student responses also supported the value of using VBS2 AAR capabilities during AARs. The larger samples and between-group design enabled inferential analysis of the student data. As seen in Table 5, students in the AAR with VBS2 condition produced significantly higher ratings for every measure of training outcomes when compared to the AAR with no VBS2 condition. Further, all of the effect sizes would be categorized as large according to standards set forth by Cohen (1992).

Students in the experimental condition provided head-to-head ratings for AARs with VBS2 versus AARs with no VBS2. The results clearly indicated that students believed the use of VBS2 tools during AARs significantly contributed to their learning experience (see Table 6). Of the 263 responses gathered across the nine questions, only 2 (.76%) indicated a negative rating for AARs with VBS2. Nearly 80% of the ratings were positive for AARs withVBS2, with 40.7% being "agree" and 38.4% being "strongly agree."

Table 5

Average Student Ratings for AAR Processes and Outcomes, by Research Condition

How much do you agree or disagree that the AAR was conducted in a manner that:	AAR with no VBS2 $n = 22$	AAR with VBS2 $n = 31$	*t*-value	Effect Size	*p*
Leveraged all the tools to help me learn?	2.72 (.83)	3.94 (.73)	5.63	1.56	.000
Allowed me to identify any deficiencies which may have occurred?	3.32 (1.04)	4.26 (.68)	3.97	1.07	.000
Allowed me to understand how to correct any deficiencies which may have occurred?	3.23 (1.02)	4.19 (.60)	4.33	1.04	.000
Allowed me to focus on performance of mission essential tasks?	3.36 (1.09)	4.03 (.70)	2.71	.73	.009
Allowed me to identify and strengths and actions performed correctly?	3.23 (1.02)	4.03 (.71)	3.40	.91	.001
Inspired me to participate?	3.27 (.98)	4.03 (.75)	3.19	.87	.002

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Table 6

Average Student Ratings for Training Impact of AARs with VBS2 (Experimental Condition Only)

How much do you agree or disagree that:	*n*	Mean (*SD*)
The value of performing a mission in VBS2 was enhanced by watching the video playback of critical events during the AAR?	31	4.38 (.61)
A video playback of the VBS2 exercise is useful during the AAR?	31	4.50 (.51)
A video playback from the VBS2 exercise enables me to visualize the AO and actions during an AAR?	31	4.34 (.60)
A video playback from the VBS2 exercise should be a standard component of an AAR following a VBS2 training mission?	31	4.31 (.69)
Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to identify any deficiencies which occurred?	29	4.00 (.84)
Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to understand how to correct deficiencies?	29	3.90 (.84)
Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to focus on performance of specific tasks?	29	3.87 (.86)
Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to identify strengths & actions performed correctly?	26	4.07 (.73)
Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback inspired me to participate?	26	4.00 (.92)

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Aggregated across participants and measures, the data overwhelmingly supported the use of VBS2 AAR capabilities during AARs. Instructors and students uniformly rated VBS2 AAR

features as having a positive effect on learning outcomes. Observational data and participant ratings were in agreement, indicating that students participated more during AARs with VBS2. Instructors and students rated AARs with VBS2 more favorably than AARs with no VBS2. Finally, participants' comments reflected positively on the benefits of VBS2 AAR capabilities.

Impact of VBS2 AAR Capabilities on Perceptions of Simulation-Based Training

Past research indicated that Soldier "buy-in" remains a significant obstacle to the effective use of GBT (Topolski, Leibrecht, Cooley, Rossi, Lampton, & Knerr, in preparation). Instructors and students alike often treat simulations as a game, failing to take the learning objectives seriously. During the material development phase of this research, investigator observations and interview feedback from instructors and course managers suggested that the VSB2 AAR capabilities were currently being underutilized during AARs. As part of the experimental investigation, the researchers explored the impact of VBS2 AAR capabilities on Soldiers' perceptions of simulation-based training.

Instructor data

Table 7 shows instructor ratings for computer-based combat simulations after completing an AAR using VBS2 AAR capabilities. The data could be generally described as neutral to positive. While half of the ratings were neutral, the remaining half were positive.

Table 7
Instructor Ratings for Effectiveness of Computer-Based Combat Simulations

How much do you agree or disagree that computer-based combat simulations in general:	Instructor 1	Instructor 2	Instructor 3	Mean (*SD*)
Are an effective training tool?	3	3	4	3.33 (.58)
Build students' tactical knowledge?	3	3	4	3.33 (.58)
Increase students' procedural knowledge?	3	4	5	4.00 (1.00)
Provide valuable lessons that students can apply on the job to improve the unit's performance?	3	4	5	4.00 (1.00)

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Student data

Student data provided stronger support for the positive impact of VBS2 AAR capabilities during AARs on simulation-based training. Students in the AAR with VBS2 condition rated simulation-based training more favorably than students in the AAR with no VBS2 condition, as seen in Table 8. Two of the four items addressing training impact yielded statistically significant differences between conditions, while the other two produced nearly significant differences (i.e., $p < .10$). Further, most of the effect sizes were moderate to large, indicating that using VBS2 AAR capabilities during the AAR had a substantial impact on how students viewed simulation-based training overall.

Table 8

Average Student Ratings for Effectiveness of Computer-Based Combat Simulations, by Research Condition

How much do you agree or disagree that computer-based combat simulations in general:	AAR with no VBS2 $n = 22$	AAR with VBS2 $n = 31$	*t*-value	Effect Size	*p*
Are effective training tools?	3.32 (1.04)	3.81 (.75)	1.94	.54	.058
Build tactical knowledge?	3.14 (1.09)	3.81 (.75)	2.97	.72	.004
Increase procedural knowledge?	3.27 (1.12)	3.74 (.89)	1.70	.46	.09
Provide valuable lessons learned that I can apply on the job to improve my unit's performance?	3.09 (1.02)	3.77 (.84)	2.66	.73	.01

Note. The rating scale ranged from 1 (strongly disagree) to 5 (strongly agree). Figures in parentheses are standard deviations.

Students' written comments corroborated the quantitative data. Students in the AAR with VBS2 condition tended to provide more positive comments regarding simulation-based training than students in the AAR with no VBS2 condition. For example, comments from students in the AAR with VBS2 condition highlighted the added value of having a reviewable record of events during the AAR: (a) "I would rate the AAR playback as the key component which makes VBS2 a valuable training tool," (b) "I think this part of the program is the most effective part. It helps identify command and control decisions and helps leaders be able to see their flaws or weak points," and (c) "Very effective in all ways. It keeps people honest on how and where improvement is needed." In comparison, students in the AAR with no VBS2 condition had less positive comments regarding simulations, such as "This system is a waste of time and money," and "It's garbage." Other comments reflected an understanding that the system could be utilized more effectively by instructors: (a) "We haven't had the chance to utilize the software to its full potential," and (b) "It all depends on how Cadre run through simulations – at other facilities I have had Cadre almost treat it like a game where they are competing against the students – in those instances nothing was learned."

Participants' comments indicated a need for more VBS2 workstation training and fewer technical issues. Representative student comments included: (a) "If we had more train-up things would run more smoothly," (b) "The first few hours of running a mission you are trying to learn the controls and the capabilities more than accomplishing the mission," and (c) "We were never used to the controls and the system always locked up." Instructors' comments were typified by "We're still trying to figure out how to use the system." Members of the research team noted that VBS2 proficiency and use were very uneven across instructors. The instructors who were less proficient operators often relied on the more seasoned instructors for tips and guidance on how to use VBS2, resulting in a piecemeal development of VBS2 capabilities.

Finally, participants from both research conditions commented that technical issues were pervasive. Example comments included: (a) "With simulators technical problems dominate the training," (b) "With this system, sometimes it's a 50/50 shot of the network working," and (c) "We waste a lot of time getting the system to operate correctly." These comments agreed with

observations made by the research team. Technical problems were not uncommon during the execution phase of the VBS2 exercises, but occurred less frequently during the AARs. During the execution phase, the system occasionally locked up and students were often dropped from the simulation. It is important to note that several factors likely contributed to these technical challenges, including software and hardware limitations, and inexperienced VBS2 operators.

Conclusions and Recommendations

Conclusions

The results from the formative evaluation and exploratory investigation indicate that the *VBS2 AAR Guide* is an effective and useful tool for facilitators as part of simulation-based training with VBS2. Instructor and SME feedback indicates the Guide is solidly constructed, addresses an area of need, and is a welcomed resource. Observational data, instructor and student ratings, and instructor and student comments reveal consistent support for the benefits of using the *VBS2 AAR Guide* to conduct AARs with VBS2. The results demonstrate higher ratings across all measures for AARs conducted using the VBS2 workstation capabilities.

The VBS2 AAR features provide a reviewable record that helps units discuss collective or individual actions. The Guide provides a general framework for facilitators to leverage the different views afforded by VBS2 to illuminate specific troop actions and critical events. The facilitators who participated in this research demonstrated effective control of the content presented to students by using bookmarks, playbacks and playback pauses, free camera views, and first-person views. They employed these tools to review the commander's mission and intent, discuss teaching points, review TTP, and increase student accountability.

Currently, the AAR capabilities of VBS2 are being underutilized by facilitators and trainers. Interviews with instructors and observations by researchers indicate that only a small fraction of facilitators are currently using the VBS2 AAR capabilities during AARs. Instructor and student "buy-in" for the value of simulation training remains an issue. Evidence from this research indicates that using VBS2 AAR capabilities significantly increases Soldier perceptions of the positive value of simulation-based training. Using the VBS2 AAR features significantly increases the extent to which Soldiers take "serious games" seriously. Learning outcomes are likely to improve if more facilitators use VBS2 AAR capabilities during AARs. The *VBS2 AAR Guide* is a valuable resource for assisting facilitators with this effort.

The research presented here is limited by several factors. The feedback and data from instructors in the formative evaluation and exploratory investigation were sparse, limiting the conclusions that can be drawn. The conclusions are also limited by the sample of instructors being self-selected rather than randomly assigned. That is, the instructors who chose to conduct their AAR with VBS2 were likely instructors already VBS2 savvy and holding a more positive view of simulation-based training.

Finally, several limitations are associated with the *VBS2 AAR Guide*. The Guide is limited in scope because it is designed specifically for VBS2. In its current state, it is not generalizable beyond AARs following simulation-based training missions using VBS2 as the

simulation platform. Constructing similar guides for other simulation platforms may be warranted. Potential obstacles for instructors using the Guide may include increased time demands in planning and preparing for AARs and time lost to technical difficulties.

Lessons Learned

In conducting the research described in this report, the investigators identified several noteworthy lessons learned.

- Employing the special feedback capabilities of GBT software to improve AARs is a training multiplier that produces practical benefits in several ways. In the current research, the use of VBS2 AAR tools not only enhanced the AAR process and outcomes but also increased the receptiveness of Soldiers to simulation-based training. However, the value of using the special AAR capabilities may not be self-evident. Without education regarding the payoff of mastering and utilizing GBT-based AAR tools, trainers and AAR facilitators may not realize the benefits to be gained. Thus, deliberate steps are needed to inform trainers and then build their ability to use the new tools. Supporting packages such as the *VBS2 AAR Guide* can directly support those steps.

- Individual differences can be expected among facilitators who use the Guide. While the Guide provides a general framework and suggestions on how to use the VBS2 AAR capabilities, trainers exhibit stylistic differences in VBS2 use. The flexibility of optional views allows AAR facilitators to choose different perspectives for specific situations. For example, one facilitator may choose a first-person view to show the enemy's position, while another might use the enemy's line of sight to indicate their location and intent. Variations between facilitators likely stem from individual differences in openness to technology, instructional styles, etc. The differences are worthy of follow-up research to determine which views or other feedback features are the most effective teaching tools.

- Factors in the training environment are likely to hinder efforts to promote the use of GBT-based AAR tools. Skepticism about simulation-based training, habits acquired as part of traditional AARs, and unit training guidance that ignores GBT-based AAR techniques can work against employment of specialized feedback capabilities. In the absence of personal evidence of the benefits of using simulation-specific feedback tools, trainers may well find it hard to justify expending sufficient time and effort to become proficient with the tools. Further, the scarcity of opportunities and resources for training on GBT-based AAR tools stands in the way of trainers who want to become GBT-savvy AAR facilitators. Obstacles in the training environment should be taken into account when planning and resourcing simulation-based training programs. These programs would do well to include AAR-specific support materials such as the *VBS2 AAR Guide*.

- Clearly defining what trainers need to help them build Soldiers' TTP-based competencies can be a challenge. In the current project, the initial concept of the training need—VBS2 generated videos illustrating high priority TTP—evolved into the much different concept of guidelines for conducting VBS2-based AARs. This evolution was driven largely by input from the target audience regarding what schoolhouse AAR facilitators really need

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to help them exploit VBS2's AAR tools. The input occurred via face-to-face dialogue in iterative fashion, which was critical to the success of the front-end analysis. Future research/development teams can profit by investing the effort to carefully define the training support need from the user's perspective.

- Involving target audience representatives in the development efforts is critical to creating a useful training support product. By building close working relationships with the target audience and leveraging their input, the current researchers were able to incorporate user desires and preferences throughout the development process, including feedback-based revision of the primary product. The collaboration between researchers and users was an important factor in the project's success. It fostered a sense of ownership among the target audience and brought considerable credibility to the *VBS2 AAR Guide*. Building a product that can help trainers and Soldiers do their jobs more effectively can increase users' willingness to adopt the product as a valuable resource.

- Creative approaches must be employed to collect effective data from institutional and unit trainers. Trainers in both arenas are often heavily burdened with multiple duties that compete for their time. Innovative data collection strategies must be developed and implemented to (a) identify available samples and (b) incentivize participants to provide quality feedback. For example, forming relationships with military leaders and trainers can prove invaluable when collecting data. Coordinating a data collection plan with these individuals is a key to success. Alternatively, online communities of practice such as the MilGaming forum may provide an avenue for data collection. In that approach, posting a product on a website for review can yield valuable feedback from Army developers and practitioners.

Recommendations

Based on the results of the formative evaluation and exploratory investigation, we make the following recommendations for simulation-based training:

- Increase the use of VBS2 AAR capabilities: While numerous organizations are using VBS2 exercises for training, seemingly few facilitators are employing the VBS2 AAR features during their AAR sessions. This research provides clear support for the value of using VBS2 AAR features. Learning outcomes and Soldiers' acceptance of simulation-based training are significantly enhanced through the use of VBS2 AAR capabilities.

- Transition the *VBS2 AAR Guide* to Army units and institutions: The formative evaluation indicates that the Guide is well constructed. Evidence from the exploratory investigation suggests the Guide is an effective tool for leveraging the benefits of VBS2 AAR capabilities. Transitioning the Guide throughout the Army could accelerate the use of VBS2 AAR capabilities and help maximize the benefits of simulation-based training.

- Increase Workstation proficiency: Proficiency on workstation operations is critical to successful simulation-based exercises. A VBS2 Workstation consists of an instructor or lead trainer computer that is acting as the server for the mission being conducted.

Proficiency on this station, which includes the networking and AAR functions of the system, affords trainers greater flexibility to impart teaching points or lessons learned. Soldiers are less inclined to use and value systems on which they are not proficient. Substantial train-up is required for the training audience to achieve workstation proficiency, and the train-up must be enabled by Soldier-friendly training support materials. Innovative techniques are required to produce acceptable proficiency in the compressed timeframe typical of today's units and courses.

- Improve Workstation functioning: The U.S. Army has made a substantial investment in VBS2 as a realistic, low-cost virtual training environment. However, the workstations and networks often fail to meet the demands of the software and users. Valuable training time is lost when frequent system failures occur, and Soldiers' perceptions of simulation-based training suffer. More resources should be allocated for mitigating technical issues through better equipment, increased technical support, and improved training.

- Conduct additional research to track the implementation/utilization of the Guide: The current research was exploratory in nature. Several factors limited the methodology and data collection. As such, the conclusions are limited as well. Additional research may be warranted to monitor and document the dissemination and utilization of the Guide. Such research could gather operational feedback and lessons learned.

- Cross-reference the Guide in the *VBS2 Administrator Manual*: The Guide has been shown to be a valuable resource for trainers of VBS2 exercises. By incorporating a reference to the Guide in the *VBS2 Administrator Manual*, AAR facilitators can be made aware of the Guide and its positive impact on training outcomes.

- Designate an Army proponent for the *VBS2 AAR Guide*: Given the Guide's potential value in optimizing the Army's return on its VBS2 investment, it may be worth naming an agency as the cognizant proponent for the Guide. The role of the proponent agency would be to manage the dissemination and maintenance of the Guide and to serve as an advocate for programmatic and resource matters.

- Include a usage guide with future fielding of GBT Systems: Future GBT Systems should include a usage guide that preferably precedes the release of the software to the field. This would empower instructors to begin strategizing how to utilize the software prior to fielding.

This report documents the creation and formative evaluation of the VBS2 AAR Guide. The Guide was developed to help facilitators optimize the effectiveness of AARs of VBS2 missions. It is a valuable addition to the Soldiers' Toolbox for Developing TTP (Topolski et al., 2010). Observational data suggests that there is a clear need for the Guide. The results of the formative evaluation and investigation provide converging evidence that the Guide fulfills that need. The results also strongly suggest that effectively employing VBS2 AAR capabilities during an AAR is a cardinal component in producing "buy-in" for simulation-based training among facilitators and Soldiers. Robust dissemination and utilization of the Guide can directly support Army efforts to capitalize on low-cost, high-flexibility simulation-based training technology.

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Appendix A

Acronyms and Abbreviations

AAR	After Action Review
ALC	Advanced Leaders Course
AO	Area of Operation
ARC	Army Reconnaissance Course
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
BOLC	Basic Officer Leaders Course
CCTT	Close Combat Tactical Trainer
GBT	Game-Based Training
M	Mean (average)
MMORPG	Massively Multiple Online Role-Playing Game
N	Sample Size
n	Sub-Sample Size
OE	Operational Environment
p	Probability Level
PC	Personal Computer
SD	Standard Deviation
SIMNET	Simulation Networking
SME	Subject Matter Expert
SOP	Standing Operating Procedures
TSOP	Tactical Standing Operating Procedures
TTP	Tactics, Techniques, and Procedures
VBS2	Virtual Battlespace-2

Appendix B

Data Collection Instruments

INSTRUCTOR FEEDBACK FORM

Instructor's Name: _____   *Date*: _____

<div style="border:1px solid black; background:#cccccc; padding:10px;">

Instructions

Please use this form to record your feedback for the Suggested Guidelines for Integrating a VBS2 AAR Playback into a VBS2 Mission AAR. The research team will collect it when you are finished.

</div>

1. **Prior to conducting your AAR, how much time did you spend on reviewing the guide?**

2. **Do you believe the time you spent reviewing the Guide was sufficient to fully understand the contents of the Guide?**

3. **What is the most useful part of the *Guide*? Why?**

4. **Which parts of the *Guide* are unclear or confusing? Please explain.**

5. **Of the current topics covered in the Guide, please indicate which if any needs to be expanded upon. (Check all that apply)**

☐ Purpose of the Guide
☐ Why use the VBS2 AAR Playback
☐ Skills Needed
☐ Integrating VBS2- Planning
☐ Integrating VBS2- Preparation
☐ Integrating VBS2- Conduct the AAR
☐ Appendix A- Capabilities
☐ Appendix A- Virtual, Live, Constructive
☐ Appendix A- Scenario Development
☐ Appendix A- AAR
☐ Appendix A- Terrain Types
☐ Appendix A- Training and Mission Specific Applications
☐ Appendix A- Limitations
☐ Appendix A- Mitigating Limitations

6. **Of the items you checked in question 5, please briefly explain what needs to be expanded upon within a specific section.**

7. **Below is a short list of topics which could be added to the Guide. Please indicate which items would be useful to add to the Guide. (Check all that apply)**

☐ Application Scenario (to provide an example of who would benefit from the guide)
☐ An Appendix outlining a sample VBS2 AAR which matches VBS2 capabilities to AAR events
☐ An appendix of "hot keys" and VBS2 functions
☐ Flow chart or diagram to outline the VBS2 AAR process

8. **How would you improve the *VBS2 AAR Instructor's Guide*?** (Consider organization, contents, and packaging.)

9. **Other comments?**

AAR Observation Form
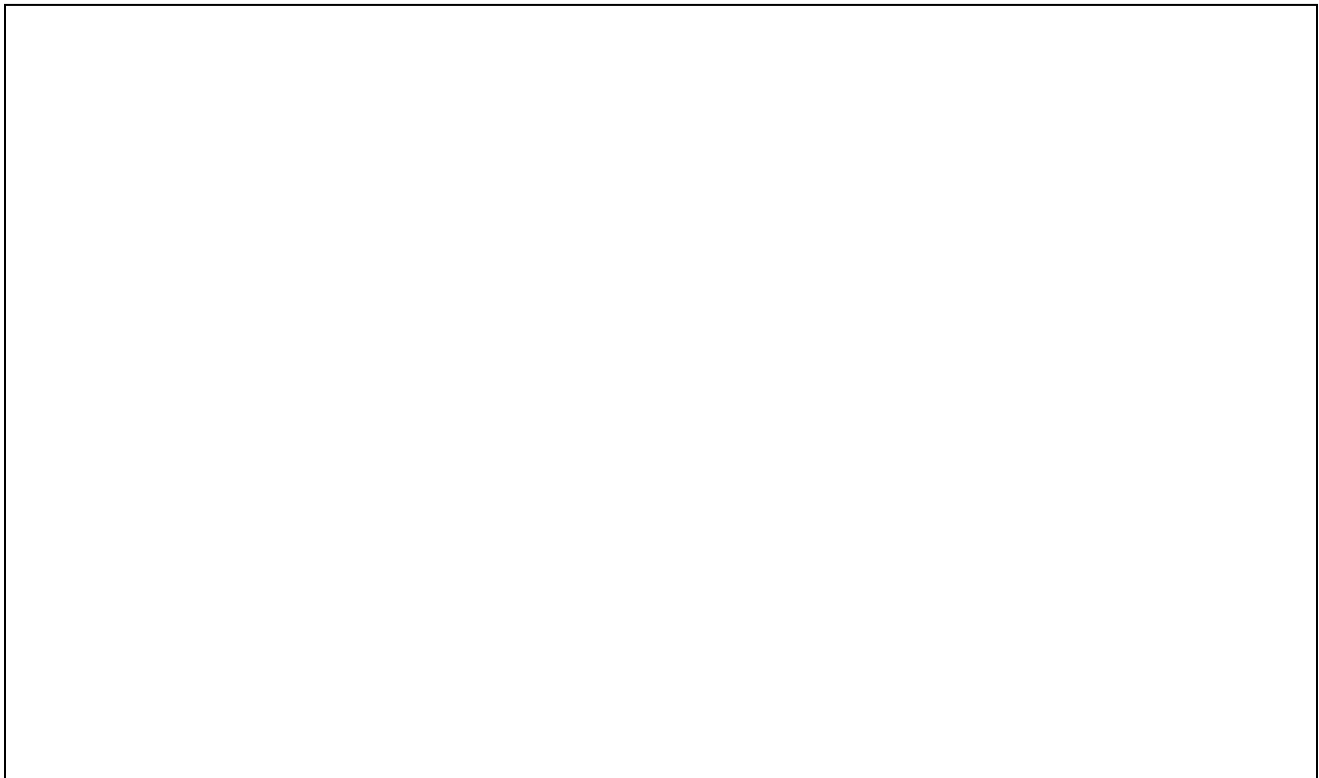
Part I: EVENT DETAILS

Administrative Data

1. Observer: _____

2. Course Name: _____

3. Location (Installation + Room # or Field Site): _____

4. Date: _____

5. Exercise Name: _____

6. # of instructors: _____   # of students: _____

7. AAR Condition (circle one):   Baseline   /   VBS2-Enhanced

8. Describe the training site, to include # of workstations; sketch a diagram of the site below.
_____
_____
_____

9. AAR Start Time: _____

10. AAR Stop Time: _____

Diagram of site (sketch):

Part II: TIME-SAMPLING CHRONOLOGY

PARTICIPANT ACTIVITIES	IQ – Instructor Queries	IS – Instructor Sketches or Writes	IV – Instructor Uses VBS2 Functions	SR – Student Responds to VBS2
ID – Instructor Describes	SQ – Student Queries	SS – Student Sketches or Writes	IG – Instructor Guides VBS2 Interpret'n	IF – Instructor Fixes VBS2 Problem
SD – Student Describes	SI – Students Interact	IU – Instructor Sets Up VBS2-AAR	IE – Instructor Errs in Operating VBS2	IA – Instructor Aborts VBS2 Action

VBS2 ACTIONS	PN – Playback No Bookmark	FP – Use First Person View	PP – Pause Playback	HL – Use Hit Lines
DM – Display Mission Briefing	PB – Playback via Bookmark	MP – Use Mouse Arrow/Pointer	BT – Use Bookmark Timestamp(s)	SK – Save Key Points to File
FC – Use Free Camera Views	LO – Lock Onto Entity	AT – Use Audio Track	BN – Use Bookmark Notes	OO – Other (Describe)

Block (Time)	Activity Codes	Description of instructor and student behaviors, interactions, and VBS2 operations	VBS2 Action Codes

Part II: TIME-SAMPLING CHRONOLOGY (continued)

PARTICIPANT ACTIVITIES	IQ – Instructor Queries	IS – Instructor Sketches or Writes	IV – Instructor Uses VBS2 Functions	SR – Student Responds to VBS2
ID – Instructor Describes	**SQ** – Student Queries	**SS** – Student Sketches or Writes	**IG** – Instructor Guides VBS2 Interpret'n	**IF** – Instructor Fixes VBS2 Problem
SD – Student Describes	**SI** – Students Interact	**IU** – Instructor Sets Up VBS2-AAR	**IE** – Instructor Errs in Operating VBS2	**IA** – Instructor Aborts VBS2 Action

VBS2 ACTIONS	PN – Playback No Bookmark	FP – Use First Person View	PP – Pause Playback	BN – Use Bookmark Notes
DM – Display Mission Briefing	**PB** – Playback via Bookmark	**MP** – Use Mouse Arrow/Pointer	**BT** – Use Bookmark Timestamp(s)	**SK** – Save Key Points to File
FC – Use Free Camera Views	**LO** – Lock Onto Entity	**AT** – Use Audio Track	**HL** – Use Hit Lines	**OO** – Other (Describe)

Block (Time)	Activity Codes	Description of instructor and student behaviors, interactions, and VBS2 operations	VBS2 Action Codes

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Part III: SUPPLEMENTARY INFORMATION

1. What level of VBS2-AAR proficiency did the instructor exhibit? (circle one)

   Not Observed   Little Proficiency   Moderate Proficiency   Strong Proficiency   Expert Proficiency

2. Following ENDEX, how did the instructor prepare for the AAR?

3. At the beginning, how did the instructor explain the role of the VBS2 capabilities in the AAR?

4. How did the instructor encourage all students to participate in the AAR?

5. How did the students respond to the VBS2 AAR capabilities? Consider comments, questions, body language, "ah-hah!" reactions, enthusiasm, energy level, etc.

6. How did the instructor evaluate student performance?

   a. _____ Job Aid from the *Instructor's P2P Learning Guide*

   b. _____ Specialized assessment form (obtain a blank copy if possible)

   c. _____ Other (describe): _____

   d. _____ Student performance was not evaluated

7. How much did the instructor employ VBS2-AAR capabilities during the AAR? (circle one)

Not At All   Once or Twice   Occasionally (Missed Chances)   Often (Whenever Appropriate)   Too Much

Comments:

8. What evidence did you see that the instructor used ARI's VBS2 AAR guidelines?

9. How many students participated fully in the AAR? (circle one)

None   One   About One-Quarter   About Half   About Three-Quarters   All of the Students

Comments:

10. How did the instructor depart from the procedures outlined in TC 25-20?

11. Were there any innovative AAR techniques that deserve special mention? If so, describe them.

INSTRUCTIONS – HOW TO USE THIS FORM

This form is to be used by a VBS2-savvy SME to record observation data during AARs conducted as part of VBS2 exercises of interest.

STAGES:

1. Advance preparation: Study the entire form before the scheduled event begins.

2. Part I: Complete items 1-8 as the AAR is getting ready to start. Record actual AAR start time and stop time in local time (military format).

3. Part II: Record chronology data continuously using the table provided.
   - Break the data recording into consecutive 3-minute blocks.
   - In column 1, record the start time of each block (to the nearest minute).
   - In column 2, record the code for each activity observed at least once during the block.
   - In column 3, describe individual behaviors, interpersonal interactions, VBS2 operations, and disruptions; include examples of activities. When in doubt, write it down!
   - In column 4, record the code for each VBS2 action observed at least once during the block.

4. Part III: Complete all items after the AAR ends. Glance at the items occasionally during the AAR to maintain awareness. Capture as much information as possible.

ACTIVITY CODES DEFINED:
- **ID** – Instructor describes/explains/clarifies mission, actions, events, messages, etc.
- **SD** – Student describes/explains/clarifies mission, actions, events, messages, etc.
- **IQ** – Instructor queries student(s) to explain or clarify a point (pinpoint or open-ended questions)
- **SQ** – Student queries instructor to obtain explanation or clarification of a point
- **SI** – Student interacts with another student to explain a point, obtain clarification, etc.
- **IS** – Instructor sketches or writes on white-board or butcher paper
- **SS** – Student sketches or writes on white-board or butcher paper
- **IU** – Instructor sets up VBS2 workstation in preparation for AAR support
- **IV** – Instructor uses VBS2 function(s) to display, highlight, illustrate, clarify, answer questions, etc.
- **IG** – Instructor guides students to help them interpret VBS2 displays and imagery
- **SR** – Student responds to VBS2 display by means of comments, questions, body language, etc.
- **IE** – Instructor errs in operating VBS2, identifying a problem, or representing VBS2 information
- **IF** – Instructor fixes a technical problem, including troubleshooting and corrective action
- **IA** – Instructor aborts a VBS2 action because of limited proficiency or technical problem

VBS2 ACTION CODES DEFINED:
- **DM** – Display Mission Briefing to reiterate the training objectives
- **FC** – Use Free Camera view(s) to show AO, illustrate a teaching point, etc.
- **PN** – Playback a portion of the exercise using no bookmarks
- **PB** – Playback a portion of the exercise using one or more bookmarks
- **LO** – Lock onto a vehicle or dismount (friendly or enemy) to show a certain perspective
- **FP** – Use first-person view to show what a student was seeing
- **MP** – Use mouse arrow or pointer device to highlight key elements in the VBS2 display
- **AT** – Use audio track during playback to clarify tactical radio communications
- **PP** – Pause the playback while a critical point is discussed
- **BT** – Use bookmark timestamp(s) to clarify timing of key event(s)
- **BN** – Use bookmark notes to organize or highlight teaching point(s)
- **HL** – Use hit lines to verify shooter-target identification and timing
- **SK** – Save key points and/or VBS2 materials to digital file(s) for exporting
- **OO** – Other action involving VBS2 workstation (describe)

INSTRUCTOR PROFILE AND SURVEY

Instructions: The questions below ask for your opinions about VBS2 and the AAR you just completed. Write-in comments, both positive and negative, are encouraged. Please use a separate sheet of paper if you need additional space.

Rank (current or retired): _____   Branch/MOS: _____

Time on active duty: _____ yrs _____ mos   Unit: _____

Time as Instructor for this course ____yrs _____mos

1. Did you have prior instructor's experience with VBS2? (Circle one and explain.)

  0-None   1-Little Experience   2-Some Experience   3-Much Experience

_____

_____

2. Did you have prior experience with other computer-based combat simulations (e.g. DARWARS-AMBUSH)? (Circle one and list which ones.)

0-None   1-Little Experience   2-Some Experience   3-Much Experience

_____

_____

3. How much basic VBS2 training have you received? (Circle one and list which ones.)

0-None   1-Little Experience   2-Some Experience   3-Much Experience

_____

_____

4. How much VBS2 AAR training have you received? (Circle one and list which ones.)

0-None   1-Little Experience   2-Some Experience   3-Much Experience

_____

_____

5. How much experience have you had with personal computers? (Circle one and list which ones.)

0-None   1-Little Experience   2-Some Experience   3-Much Experience

_____

_____

6. How much do you agree or disagree that computer-based combat simulations in general:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. are an effective training tool?	1	2	3	4	5
b. build students' tactical knowledge?	1	2	3	4	5
c. increase students' procedural knowledge?	1	2	3	4	5
d. provide valuable lessons that students can apply on the job to improve the unit's performance?	1	2	3	4	5

Comments and Clarifications:

7. How much do you agree or disagree that:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. VBS2 playbacks enhance the AAR by providing a viewable record to draw teaching points from?	1	2	3	4	5
b. VBS2 playbacks during AARs promote accountability by eliminating uncertainty about who did what?	1	2	3	4	5
c. VBS2 playbacks during AARs make it easier to focus on performance of specific mission essential tasks?	1	2	3	4	5
d. VBS2 inspires students to participate in the AAR?	1	2	3	4	5
e. Varying the camera angles of the VBS2 playback allows for better visualization of the battlefield?	1	2	3	4	5
f. Alternating between friendly and enemy Soldiers' point of view fosters discussion about tactical and procedural teaching points?	1	2	3	4	5
g. The value of performing a mission in VBS2 was enhanced by watching the video playback of critical events during the AAR?	1	2	3	4	5
h. A video playback of the VBS2 exercise is useful during the AAR?	1	2	3	4	5
i. A video playback from the VBS2 exercise should be a standard component of an AAR following a VBS2 training exercise?	1	2	3	4	5
j. The VBS2 AAR Guide is a useful resource for conducting VBS2 enhanced AARs?	1	2	3	4	5

Comments and Clarifications:

8. Compared to traditional AARs, how much do you agree or disagree that:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. the VBS2 playbacks made your job easier as the instructor by providing a viewable record of events?	1	2	3	4	5
b. the free camera view and map views (2-D and 3-D) provide a better display of the AO?	1	2	3	4	5
c. the VBS2 playback better enables students to visualize the AO and actions during an AAR?	1	2	3	4	5
d. VBS2 playback provides additional detail and clarity of the events that occurred during the exercise?	1	2	3	4	5
e. the VBS2 playback better allows students to identify any deficiencies which may have occurred?	1	2	3	4	5
f. the VBS2 playback better allows students to understand how to correct any deficiencies which may have occurred?	1	2	3	4	5
g. the VBS2 playback better allows students to focus on performance of specific mission essential tasks?	1	2	3	4	5
h. the VBS2 playback better allows students to identify any strengths and actions correctly performed?	1	2	3	4	5
Comments and Clarifications:					

9. How much do you agree or disagree that the VBS2 AAR Guide:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. is a useful aid for incorporating VBS2 tools into an AAR?	1	2	3	4	5
b. is clearly written?	1	2	3	4	5
c. contains the right level of detail for facilitators?	1	2	3	4	5
d. avoids unnecessary or excess information?	1	2	3	4	5
e. is well organized and easy to follow?	1	2	3	4	5
f. is a valuable addition to conduct VBS2 exercises?	1	2	3	4	5
g. can help facilitators achieve learning outcomes?	1	2	3	4	5
h. uses language familiar to facilitators?	1	2	3	4	5

Comments and Clarifications:

10. Did you encounter any problems while conducting the AAR?	Yes	No
(if yes, please explain:)		

Other Comments:

STUDENT PROFILE AND SURVEY

Instructions: The questions below ask for your opinions about the AAR you just completed. Write-in comments, both positive and negative, are encouraged. Please use a separate sheet of paper if you need additional space.

Rank: _____   Branch/MOS: _____

Time in Service: _____ yrs _____ mos   Unit: _____

1. Did you have prior experience with VBS2 before this course? (Circle one and explain.)

   0-None   1-Little Experience   2-Some Experience   3-Much Experience

      _____

      _____

2. Did you have prior experience with other computer-based combat simulations (e.g., DARWARS AMBUSH)? (Circle one and list which ones.)

   0-None   1-Little Experience   2-Some Experience   3-Much Experience

      _____

      _____

3. How much do you agree or disagree that computer-based combat simulations in general:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. are an effective training tool?	1	2	3	4	5
b. build tactical knowledge?	1	2	3	4	5
c. increase procedural knowledge?	1	2	3	4	5
d. provide valuable lessons that I can apply on the job to improve my unit's performance?	1	2	3	4	5
Comments and Clarifications:					

4. How much do you agree or disagree that the AAR was conducted in a manner that:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Leveraged all the tools available to help me learn?	1	2	3	4	5
b. Allowed me to identify any deficiencies which may have occurred?	1	2	3	4	5
c. Allowed me to understand how to correct any deficiencies which may have occurred?	1	2	3	4	5
d. Allowed me to focus on performance of specific mission essential tasks?	1	2	3	4	5
e. Allowed me to identify any strengths and actions performed correctly?	1	2	3	4	5
f. Inspired me to participate?	1	2	3	4	5

Comments and Clarifications:

Other Comments:

IF VBS2 WAS NOT USED DURING YOUR AAR, THEN STOP HERE.

IF VBS2 WAS USED DURING YOUR AAR, THEN PROCEED TO THE FOLLOWING QUESTIONS.

5. How much do you agree or disagree that:	Circle One for Each Item				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. The value of performing a mission in VBS2 was enhanced by watching the video playback of critical events during the AAR?	1	2	3	4	5
b. A video playback of the VBS2 exercise is useful during the AAR?	1	2	3	4	5
c. A video playback from the VBS2 exercise enables me to visualize the AO and actions during an AAR?	1	2	3	4	5
d. A video playback from the VBS2 exercise should be a standard component of an AAR following a VBS2 training mission?	1	2	3	4	5
e. Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to identify any deficiencies which may have occurred?	1	2	3	4	5
f. Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to understand how to correct any deficiencies which may have occurred?	1	2	3	4	5
g. Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to focus on performance of specific mission essential tasks?	1	2	3	4	5
h. Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback better allowed me to identify any strengths and actions performed correctly?	1	2	3	4	5
i. Compared to AARs which did not use VBS2 playbacks, I believe the VBS2 playback inspired me to participate?	1	2	3	4	5

Comments and Clarifications:

Other Comments:

HOTWASH PROTOCOL

> **Notes for the Hotwash Facilitator**
> **Purpose:** To feedback from Instructors regarding the VBS2 AAR Guide and conducting an AAR withVBS2
> **Time:** There is a 30-minute time limit on the hotwash
> **Data Recording:** Take written notes and tape record all comments
> **Data Transfer:** Forward all notes and tape recordings to the Lead Scientist ASAP

1) Did you have enough time available to study the guide in advance? How much time would you need?

2) How does the AAR with VBS2 differ from what you typically do during an AAR?

3) Is performing the AAR with VBS2 worth the time and effort?

4) What is the biggest benefit from using VBS2 playback during an AAR?

5) What is the biggest drawback of using VBS2 playback during an AAR?

6) Do you have any comments you would like to share about the bookmarking or timestamp tools of VBS2?

7) Which VBS2 AAR tools did/would you choose not to use? Why?

8) Is there a feature you would like to see added to the VBS2 specifically for AARs?

9) What concerns do you have about the VBS2 AAR Guide?

10) What concerns do you have about conducting an AAR with VBS2?

11) Any other comments or thoughts you would like to share?

Appendix C

VIRTUAL BATTLESPACE 2 (VBS2)

AFTER ACTION REVIEW (AAR) GUIDE

♦♦ *A Training Support Tool* ♦♦

About This Guide

This tool gives AAR facilitators a set of guidelines for conducting AARs of VBS2 missions. By exploiting VBS2's special AAR capabilities, the Guide is designed to enhance learning for the training audience.

Developed by:

U.S. Army Research Institute for the Behavioral and Social Sciences
Fort Hood, Texas

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What's Inside …

What is VBS2?

♦ VBS2 is a first-person shooter, semi-immersive, virtual training simulation.
♦ The multi-player simulation runs on a network of PC-based workstations.
♦ VBS2's virtual environment enables players to operate and interact realistically.
♦ A VBS2-proficient trainer controls exercises, serving as the system administrator.
♦ VBS2 provides special AAR tools that can enhance the feedback process.
♦ See "Basic Capabilities and Limitations of VBS2" below for more information on VBS2.

What are VBS2's AAR tools?

♦ Visualization tools such as terrain maps, versatile area of operations (AO) views, and hit lines.
♦ Playback features that recreate visual and audio dimensions of the mission.
♦ Teaching point tools such as mission briefing, bookmarking, and notes.
♦ Timestamp features that help verify timing and chronological sequence.
♦ Take-home tools such as saving mission segments and editing/exporting files.

♦ See "AAR Capabilities of the VBS2 Workstation" below for information on when to use each tool.

Why use the VBS2 AAR tools?

♦ Eliminate uncertainty about who did what.
♦ Make the AARs more interesting.
♦ Optimize Soldier participation.
♦ Sharpen battlefield visualization skills.
♦ Strengthen the learning process.
♦ Enhance the effectiveness of the AARs.
♦ Improve the learning outcomes.

What VBS2 workstation skills are needed?

♦ Ability to boot up and initialize the workstations in the proper sequence.
♦ Basic proficiency as a VBS2 operator, based on training and practice.
♦ Training and practice in employing the AAR capabilities of the workstation.
♦ Ability to troubleshoot and fix problems with the workstation and large display.
♦ See the summary of VBS2 capabilities in "Basic Capabilities and Limitations of VBS2" below.

How to set up the VBS2 site?

♦ Boot up and initialize the workstations in the proper sequence.
♦ Connect the controller's workstation to the large screen display and test it.
♦ Select the desired tactical communication settings to match the desired network.
♦ Conduct an operational check to make sure the VBS2 functions are working.
♦ Verify that voice-over-internet-protocol (VOIP) and interconnectivity are working.

Guidelines for integrating VBS2 into the AAR

Planning the AAR

♦ Use visualization capabilities to help formulate the AAR strategy.
  • Use the Training Mission menu option to review the training objectives.

- Use free camera mode to survey the AO, key events, likely mistakes, etc.
- Conduct virtual recon to identify key phases of the mission.
- Study the AO with various views to anticipate friendly and enemy actions.
♦ Use map capabilities to select suitable AAR terrain.
  - Use 2-D map views to become familiar with AO terrain.
  - Survey 3-D map to identify candidate AAR sites.
  - Use default camera to decide which terrain will best support AAR discussion.
♦ Review VBS2 workstation tools to choose an optimal mix for the AAR.
  - Using the section below titled "AAR Capabilities of the VBS2 Workstation," decide which VBS2 AAR tools best support the training.
  - Build specific tools (alone or in combination) into the AAR plan, by stage.
♦ Schedule adequate time to work on a VBS2 workstation during AAR planning.

Preparing for the AAR

♦ Update own proficiency as a VBS2 administrator beforehand.
  - Review the list of VBS2 workstation skills needed (above, see page 2).
  - Assess own proficiency with VBS2 AAR tools called for in the AAR plan.
  - Practice on a workstation to reach proficiency on stumbling-block skills.
♦ Dry-run the AAR before the exercise.
  - Step through the AAR plan, using the VBS2 workstation as needed.
  - Using the free camera mode, note likely points for bookmarking.
  - Position the default camera to cover critical tasks and/or likely mistakes.
  - Identify mission segments or other items to be saved for use after the AAR.
  - Finalize the AAR plan based on the dry-run.
♦ Manage AAR recording during mission execution.
  - Start the AAR recording function at the beginning of mission execution.
  - Pause AAR recording during administrative breaks, discussions, etc.
  - Use the bookmark feature to designate key events for AAR playback.
  - Use bookmark notes to save key observations for AAR discussion.
  - Maintain a list of bookmarks to use as a reminder during the AAR.
♦ Ready the controller's workstation and AAR materials after the mission ends.
  - Review bookmarks to help organize AAR discussion around teaching points.
  - Select bookmarked events to support AAR discussion.
  - Enter additional bookmark notes to guide discussion of teaching points.
  - Verify the controller's workstation is connected to the large screen display.
♦ Schedule adequate time on a VBS2 workstation during AAR preparation.

Conducting the AAR

♦ Set the AAR stage for the participants.
  • Display the Training Mission to focus participants on the training objectives.
  • Explain how the VBS2 system is being used to enhance the AAR.
  • Encourage close attention to VBS2's video and audio information.
  • Use map views or free camera "fly-over" to establish common picture of AO.
♦ Maintain the AAR focus on teaching points.
  • Use video/audio playback to highlight or clarify key teaching points.
  • Use playback and timestamps to verify the chronological order of events.
  • Use free camera views (e.g., Figure. 1) to illustrate different perspectives.
  • Use first-person views to bring specific participants into the discussion.
  • Display selected bookmark notes to support teaching points and discussion.
  • Re-display the Training Mission to re-focus on the training objectives.
  • Explain what Soldiers are seeing (e.g., third-person view, hit lines) as needed.
♦ Save AAR materials for later use.
  • In accordance with the AAR plan, save VBS2 take-home materials.
  • Save additional VBS2 materials as identified during the mission or the AAR.
  • Insert a list of saved files into the hand-written notes, with cross-references.

Figure 1. Illustrative free camera view provided by VBS2 (edited with text and arrows).
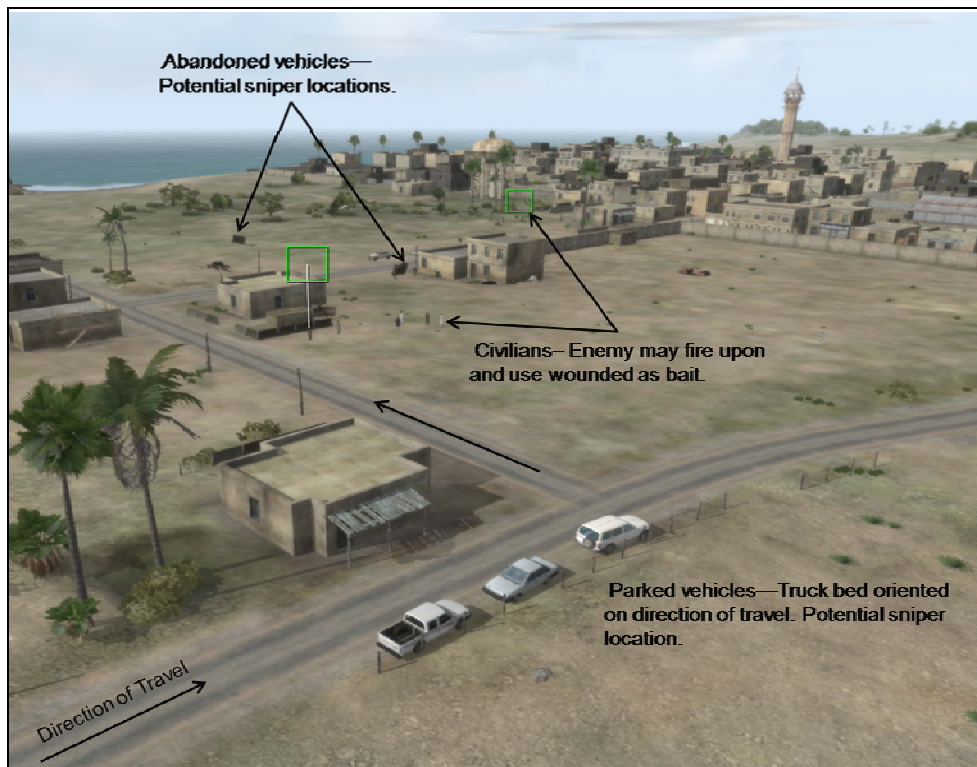
Basic Capabilities and Limitations of VBS2

Capabilities

VBS2 is a PC-based, fully interactive, three dimensional, first person shooter, synthetic environment capable of simulating a wide range of situations at the Company level and below. Users execute missions in a semi-immersive virtual environment that accurately represents the OE. The system interoperates within a Live, Virtual, Constructive (LVC) environment and interfaces with U.S. Army and Joint Command and Control (C2) systems. VBS2 accurately emulates most U.S. Army weapon systems and the effects of those weapons, both mounted and dismounted. Tactical radio communication (live radio traffic) is modeled through the use of headsets with microphones using (VOIP).

Live-Virtual-Constructive Environment

VBS2 can be federated with other High Level Architecture (HLA) compliant simulations to meet specific training outcomes. For example, dismounted infantry in VBS2 can be connected with a high fidelity armored vehicle simulator. One can also simulate a Special Forces team conducting counter-insurgency missions, while the overall campaign is controlled by a higher level constructive simulation such as OneSAF.

Scenario Development

Comprehensive scenarios can be created through the use of a Virtual Training Kit and edited while the scenario is running through the use of a Real Time Editor (RTE). Users may place the scenario in pause mode to conduct in-stride AARs and either restart the mission where it was stopped or reset the mission completely. Scenarios may be customized to the user's specific equipment and mission needs. A built-in tutorial can show players the control features and enable them to practice executing tasks.

AAR Tools

In addition to the RTE, VBS2 includes robust AAR tools allowing complete review of mission execution. Among the tools are playback of mission execution with radio traffic, and free camera views that allow the facilitator to review the actions from several angles during the playback. A bookmark feature is available that enables the administrator to mark a critical stage of the mission and quickly go back to it during the AAR.

The AAR tools may also be utilized to produce videos for communicating TTP. The TTP are executed while VBS2 captures the mission with the video/audio recording functions. The AAR file can then be edited for use as a communication tool and presented to Soldiers.

Terrain Types

VBS2's terrain database can replicate numerous geo-typical and geo-referenced terrain models around the world. Some of these terrain models are listed below.

Afghanistan	Geo-Typical	Geo-Referenced	Fictional
Kandahar Tarin Kowt	Tropical SW USA Eastern Europe Shakarat Village (Iraq)	National Training Center As Samawah (Iraq) Baghdad-Green Zone	Sahrani (multiple terrain types) Porto (island with small town) Rahmadi (small island)

Training and Mission-Specific Applications

VBS2 can be used to train individual and collective tasks in support of full spectrum operations. Combined Arms and Joint Operations missions can also be trained using VBS2. Some examples of specific training and mission-based applications are listed below.

- Mission rehearsal and/or AO familiarization,
- Tactical training,
- Crew/section battle drills,
- C2 training at the Company level and below,
- Combined Arms or Joint Training,
- Individual training,
- Collective training up to Company level,
- Convoy training (including integration of virtual reality technology),
- Improvised explosive device (IED) defeat,
- Analysis of options (decision support),
- Fire support / forward air controller training,
- Complementary virtual environment for live and constructive simulation or crew trainers,
- Navigation,
- Mission simulation (e.g., aviation elements practicing landing zone (LZ) procedures),
- Vehicle checkpoints and area control,
- Procedural training for unmanned aerial vehicle (UAV) operators,
- Cultural awareness training,
- Visualization of weapon effects,

- Weapon (or platform) familiarization or experimentation,
- Training in urban environments (e.g., military operations on urbanized terrain (MOUT) battle drills), and
- Contact drills.

Limitations

- *Limited capability to train above the Company level.* Since VBS2 is a first-person simulation, information sent to higher echelons must come from leaders executing the game. First-person simulations are video games characterized by a three-dimensional view from the player's perspective, often holding a weapon in front. Each position must have an active player in the game in order to generate combat information. Any information sent to higher echelons must come from these players. VBS2 will not generate this information on its own. Therefore training at the battalion level is dependent upon having enough units in the game to accurately represent the combat reporting sent to battalion and higher headquarters. VBS2 cannot generate this type of information without input from player units.

- *Limited ability to train hands-on tasks.* For example, the game can effectively train communi-cation within a tank crew but is not as effective at training gunnery crew drills. The desktop nature of the game limits its ability to replicate actual crew stations. Some movements or actions of the crew are artificial and do not accurately represent actual movements.

- *Limited system fidelity to capture all movements and objects during AAR recording.* The AAR does not capture every frame of action for playback. For example, a player can open vehicle doors and trunks in game but the AAR may not fully capture these actions for playback. The doors will either not open at all during playback or will only partially open. Another system fidelity limitation is the inability of the AAR to replicate objects that are replaced in the player's weapons inventory. For example, if a player is equipped with a search mirror, the mirror replaces the sidearm in the player's inventory. This mirror can be used and viewed by all players in game during AAR recording. However, the AAR will not replicate the mirror during playback, showing only the sidearm that is present in the player's inventory. These limitations may be mitigated by using video software such as FRAPS to record a player's perspective directly from their computer screen.

- *Limited ability to train full tactical communication.* VBS2's desktop nature restricts its ability to replicate actual tactical communication between echelons over distance. Use of headphones with microphones can mitigate this limitation,

but players may still be tempted to talk directly to another unit rather than use the VOIP mechanism. Separating sections by means of partitions or different rooms also helps mitigate this limitation.

Mitigating Limitations

Leaders can mitigate system limitations by carefully analyzing the training event to determine appropriate tasks for execution in VBS2 simulation. Leaders should determine the tasks that best leverage VBS2 capabilities and develop scenarios accordingly. For those tasks not well suited for VBS2, other simulations such as the Close Combat Tactical Trainer (CCTT) may be an option to exercise newly developed TTP.

AAR Capabilities of the VBS2 Workstation

The VBS2 software's primary AAR support features are outlined in the table below.

VBS2 Feature	When to Use
AAR Recording	• At the beginning of mission execution, start the AAR recording function. • Position default camera for optimal coverage during set-up of the controller's workstation.
Recording Pause	• Temporarily suspend AAR recording during breaks in mission execution.
Bookmark	• Mark a critical point during mission execution to serve as a later reference or index. • Quickly jump to a critical point during playback in AAR, using a bookmark recorded earlier.
Bookmark Notes	• Type in observations and comments during mission execution, to serve as reminder later. • Review notes during AAR preparation, to select and organize events and teaching points. • Display selected notes while conducting the AAR, to support teaching points & discussion.
Training Mission	• Display mission briefing at the AAR's start, to focus participants on training objectives. • Display mission briefing later in the AAR, to restore focus on specific training objectives.
Map View (2-D, 3-D)	• Study the AO in advance of scheduled training, to support AAR planning and preparation. • Display an AO map at the start of the AAR, to establish a big picture for the participants. • Display an AO map during the AAR, to support teaching points or respond to questions.

Free Camera View	• Recon the AO during exercise preparation, to select an optimal default camera position. • Display key views at the start of the AAR, to highlight critical areas or features of the AO. • Compare the friendly perspective with the enemy perspective (as needed) during the AAR. • Display key views during the AAR, to support teaching points or respond to questions.
Playback	• Replay bookmarked portions of the mission during AAR, to support key teaching point(s). • Replay unmarked portions of the mission, to address unanticipated points or questions. • Use audio track (radio traffic) during AAR, to support teaching points or answer questions.
Playback Pause	• Temporarily suspend playback during the AAR, while a key teaching point is discussed.
First-Person View	• Show what a friendly Soldier was seeing, to support teaching points or answer questions. • Show what an enemy Soldier was seeing, to support teaching points or answer questions. • Compare the views of two or more Soldiers, to illustrate different perspectives.
Third-Person View	• Show what an observer could see over a Soldier's shoulder, to support a teaching point. • Compare an observer's view for two or more Soldiers, to illustrate different perspectives.
Entity-Attached View	• Show the operation from the perspective of a vehicle or dismount (friendly or enemy). • Highlight key actions from the perspective of a vehicle or dismount (friendly or enemy). • Lock onto a friendly vehicle or dismount to show its actions during a critical event. • Compare the views of two or more vehicles/dismounts, to illustrate different perspectives.
Cursor/Pointer	• Use the workstation cursor to point to a key feature of a static (e.g., map) display. • Use the cursor to highlight key feature(s) of dynamic (playback) scenes or imagery. • Use the cursor to indicate objectives, boundaries, routes, obstacles, etc. on a static display.
Timestamp (Bookmark)	• Use the timestamps of selected bookmarks to confirm the chronological order of events. • Use a bookmark's timestamp to verify timing in support of a teaching point or question.

Hit Lines	• Display hit lines to identify shooters and their targets during mission playback. • Use clock-time information to determine the chronological order of firing events. • Display hit lines during playback to see who was responsible for fratricide(s) and when.
Save/Edit File	• Save portions of the mission at the end of the AAR, to be reviewed with written notes later. • Subsequently produce a video for teaching TTP, by editing a recorded file and saving it. • Convert VBS2 files to video format for exporting, so they can be played on other systems.

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* <u>Note</u>: The ADA accession number can be used to locate and download the publication from the Defense Technical Information Center website – www.dtic.mil/dtic/search/tr/index.html.

Acronyms

AAR	After Action Review
AO	Area of Operations
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
C2	Command and Control
CCTT	Close Combat Tactical Trainer
FRAPS	Video Capture Software
HLA	High Level Architecture
IED	Improvised Explosive Device
LVC	Live, Virtual, Constructive
LZ	Landing Zone
MOUT	Military Operations on Urbanized Terrain

RTE   Real Time Editor

TTP   Tactics, Techniques, and Procedures

UAV   Unmanned Aerial Vehicle

VBS2   Virtual Battlespace-2

VOIP   Voice-Over-Internet-Protocol